NORGES HANDELSHØYSKOLE

Bergen, Fall 2009

Master Thesis within the main profile of International Business

Thesis Advisor: Associate Professor Jørgen Haug

Testing the developed world: Global CAPM vs. Local CAPM

By

John Knudsen

Abstract

The purpose of this paper is to assess the extent to which the developed world is integrated that the pricing difference between using the local CAPM and the global CAPM is not relevant. This paper has analysed the twenty developed countries which have been classified as such in the MSCI global index. The paper breaks down the country and stock to identify where there is a significant difference in the pricing of assets between the local and global CAPM, and the significance of the result.

Foreword

This thesis has been written as part of my Master degree at the Norwegian School of Economics and Business Administration. The process of completing the paper has been very rewarding, despite many challenges being faced. I would like to thank my supervisor, Jørgen Haug, for the feedback and expression of support throughout the paper. In addition, all the professors which I have encountered over the last two years which have provided me with guidance and food for thought, and inspiration into my studies. Furthermore, the students from around the world which I have worked with and whom have helped me develop my skills and position myself to complete this paper.

John Knudsen

Bergen, July 2009

Table of Contents

List of Tables

List of Figures

List of Equations

1.0 Introduction

1.1 Background

The capital asset pricing model has become the model of choice for measuring the cost of equity for financial theorists for last few decades. Despite there being a number of criticisms about the model it is still the most widely used model for calculating the cost of equity and this is especially true for larger companies. However, questions have started to be raised regarding the integration between the global equity markets, are the markets fully integrated? If the markets have become fully integrated when especially addressing the developed global markets, then there is a potential case to use a global CAPM for calculating the cost of capital, rather than a local measure (Graham & Harvey, 2001).

In the developed world when the local capital market is integrated with the global capital markets, then the expected return for companies within that market with similar risks should require similar cost of equity. Whereas in a developing capital market it will be less integrated on a global scale and requires local factors to be taken into consideration. However, this paper will focus on the developed capital markets and will assess the local single-country CAPM and the global CAPM.

When the world is assumed to be fully integrated, the riskiness of investment projects in different countries should have the same cost of capital when it is expressed in common currency. There has been a lot of evidence to suggest that international integration has taken place over the last thirty years, with evidence suggesting that the expected return of financial assets is primarily determined on world market portfolio. Therefore, when this paper examines the local and global CAPM and it will use the assumption that the markets are integrated and the other costs will be ignored. Therefore, being the case that the markets are fully integrated and accessible, this paper will focus on whether the use of the local CAPM actually misprices the cost of capital, instead of using the global CAPM, which empirical evidence has to suggested is the more appropriate measure to calculate the cost of equity for an investment opportunity or project (Korajczyk & Viallet, 1989).

There has been a change over the years which moved from a US dominated world market to a more global market. More markets have become accessible and are open to foreign investors. This paper looks at a number of parameters for twenty countries in the developed world to establish the pricing mistake of using the local CAPM rather than the global CAPM.

Some of the CAPM empirical failings are examined by Fama & French (1992) using cross-section regression analysis, where they confirm that the size, earnings-price, debt-equity and book-to-market ratios all have an impact on the expected share price returns which will in fact be influenced by the beta. These studies were performed on the US market. They also performed a further study which illustrated similar results in a later paper by Fama & French (1996).

However, this study will exclude those findings and focus on the element of difference between the global and local CAPM, and the following key assumptions of the CAPM will be held (Watson & Head, 2007).

- **Investors hold diversified portfolios** - This assumption means that investors will only require a return for the systematic risk of their portfolios, since unsystematic risk has been removed and can be ignored.
- **Single-period transaction horizon** - A standardised holding period is assumed by the CAPM in order to make comparable the returns on different securities. A return over six months, for example, cannot be compared to a return over 12 months. A holding period of one year is usually used.
- **Investors can borrow and lend at the risk-free rate of return** - This is an assumption made by portfolio theory, from which the CAPM was developed, and provides a minimum level of return required by investors. The risk-free rate of return corresponds to the intersection of the security market line

(SML) and the y-axis. The SML is a graphical representation of the CAPM formula.

- **Perfect capital market** - This assumption means that all securities are valued correctly and that their returns will plot on to the SML. A perfect capital market requires the following: that there are no taxes or transaction costs; that perfect information is freely available to all investors who, have the same expectations; that all investors are risk averse, rational and desire to maximise their own utility; and that there are a large number of buyers and sellers in the market. This includes that all investors are sufficiently similar across different countries in terms of their preferences and beliefs.

1.2 Research question

The research question is addressing some of the questions which have been raised through previous studies regarding the local and global CAPM, and the pricing error which impacted the choice of model. The Stulz (1995) study took a simple example of Nestle regarding the mispricing and evaluated the need for companies to use the global CAPM due to the integration of markets and development in the financial markets over the last 20 years. However, it has not been clear the extent to the choice will affect the cost of equity for a company and the eventual decision of whether to pursue a project.

The integration of the world capital markets and importance of the CAPM within today's business decision making have made this an interesting issue to address.

1.3 Paper Scope

This paper deals the local and global CAPM. The question posed means that the developed world will be evaluated to assess the pricing error that exists between the two models, and determine the sensitivity of the developed world and industries with regards to the beta and statistical measures. Therefore, this paper will firstly evaluate the existing literature from other academics regarding this area. The literature review will assess some of the empirical findings regarding the CAPM, and then assess other parameters like the beta estimations and risk premiums. This will allow the local and global CAPMs to be evaluated and the previous tests between the models to be examined. Furthermore, it allows for the general discussion of the integration of global markets to be explored.

The next parts of the paper will focus on the methodology, data and testing that will be implemented in order to test the pricing error and general differences between the two models.

The next part of the paper focuses on the presenting the results of the testing which has been implemented linking it back to previous studies and indentifying key results which help to address the question that has been posed. The results are split into various sections to present relevant analysis.

The final part of paper concludes the findings and the relevance to the question that has been posed. This part will also address any limitations to the paper and any potential further studies that could take place to help answer questions in the general theoretical area. Furthermore, assess the practicality that the paper can have in the real world.

1.4 Desired Aim

The desired aim of this paper is to provide an insight to differences between using the local and global CAPM models in practice. This paper will review literature from the field and try to suggest a defined approach for managers to assess the cost of equity going forward. The paper will cover data from twenty developed countries as classified by MSCI throughout the world and narrow down the focus on industry analysis for the United States and Norway. This thesis provides some food for thought on the best CAPM model to use for a manager in a defined industry and country.

2.0 Review of the Literature

2.1 CAPM

The cost of capital has been studied by a number of academics throughout the years, focusing on empirical studies to more advanced analysis. The capital asset pricing Model (CAPM) is a core element of the cost of capital. This model was derived by Sharpe (1964), Lintner (1965), and Mossin (1966), the principles of the model were based on diversification.

The CAPM is widely taught and used in today's financial services industry and has become a powerful and intuitive approach to estimating the riskiness of a stock in relation to the expected return and risk. However, the CAPM is not flawless; there have been many academics that have proved theoretical failings in the model, mainly due to the simplified assumptions which are taken into account.

The CAPM was built on from the Markowitz (1959) model and turned into a testable predictor of the expected return in relation to the risk for an individual stock. The CAPM makes the assumption that there is complete agreement about returns and that all investors will see the same opportunity set. There is also the assumption that there is unrestricted risk free borrowing and lending, is quite an unrealistic assumption.

There have been a number of tests performed on the CAPM, which have involved cross sectional or time-series regressions to estimate the parameters for the model. Furthermore, the tests have assumed that that the expected returns on all assets are linearly related to their betas, and that the beta is a positive premium. This should be assumed to ensure that the key assumptions underlying the CAPM are upheld.

The assumption based on the Sharpe, Lintner and Black versions of the CAPM share the prediction that the market portfolio is mean-variance efficient. This means that the difference between the expected return across securities and portfolios is solely explained by the beta.

Stulz (1999) examined in another empirical study the evidence that globalisation reduces the cost of capital and the relationship between these entities. Two channels were identified to reduce the cost of capital. The first was that globalisation leads to a reduction in the discount rate that is charged. The second is that globalisation increases the cash flows investors expect to receive by increasing monitoring of management and controlling shareholders. However, the study suggests the effect of globalisation on the cost of capital is significant but small. In order for the cost of capital to be reduced, the shareholder base would have to be truly global.

2.1.1 Use of CAPM

The CAPM is a tool which is used by Fund Managers to predict an asset or portfolio's return for a given level of risk and market return. This can also allow the evaluation of the Fund Managers to assess whether they have outperformed the market or not. The active Fund Manager will use skill, research and informed opinions to outperform the market. In order to assess whether the manager is actually outperforming the market a benchmark is required, this is where the CAPM can be used. The CAPM provides an estimation of the return for given risk of a portfolio, and when the actual return is greater than the predicted value of the CAPM it will demonstrate that value is being added, this is also true for projects. The difference between the actual return and expected return is essentially the excess return which is obtained by the Fund Manager or project and is referred to as the alpha. Figure 1 illustrates the Security Market Line which is a graphically representation of the point where the Fund Manager and project can obtain an alpha above zero.

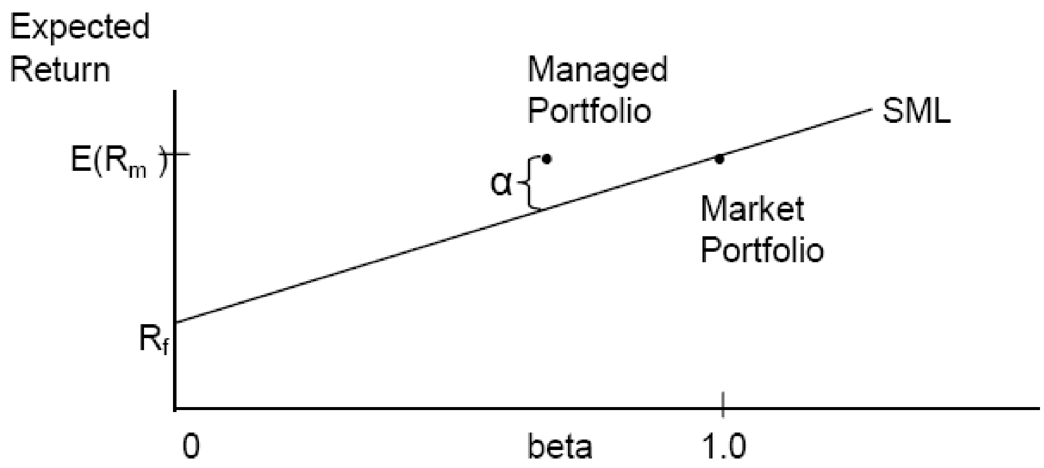


Figure 1 - Security Market Line

2.2 Beta Estimations

The systematic risk is measured in the CAPM by the factor called beta. It measures the return of an individual stock and a broad market index. The method to compute the beta is to compute the slope of best-fit line between the return of the individual stock and the broad market index.

The beta can be very different depending on the parameters that are put in place which include; the length of total time period that is being measured, the frequency of the measurement within that period, the choice of the index to use as a market proxy to whom the excess return values are measured.

Bartholdy & Peare (2003) examined relative efficiency of betas; they tested and concluded that it was best to use of monthly data and a CRSP equal-weighted index to provide a relatively efficient beta estimate. However, they had concern about the beta being able to explain the differences in the return of stocks, especially given that they were testing NYSE stocks which are perceived to be on an efficient market, and they found that the beta values explained differences in subsequent periods averaging around 3%.

A beta is key measure of the sensitivity of the movement in the returns of an individual security to the movements in the market proxy, and therefore measures the systematic risk. In the Capital Asset Pricing Model, the beta is used as a key implement in the estimation of the cost of capital. The beta can be calculated in a number of ways by varying the methodology and time frames.

Another interesting aspect with the cost of capital is whether the different currencies would impact the value. There has been a study by O'Brien (1999b) where the US dollar global CAPM was used to estimate a firm's consistent cost of capital in different currencies. The paper identified a number of points in existing literature such as an asset's global beta is not generally equal to the product of its local beta, and the global beta of the local market index. Therefore, it identified that an asset's global beta in one currency is not generally equal to the asset's global beta in a different currency.

2.3 Risk Premiums

There were tests on Sharpe-Lintner's model using cross-section regression testing which make predictions of the intercept and slope in relation to the expected return and market beta. However, some of the estimates of beta for individual assets were deemed to be imprecise. In addition, some of the regression residuals were found to have variations. This led to a development in analysis by Black, Jensen, & Scholes (1972) where portfolios rather than individual stocks were used. The estimations from these portfolios were more precise using a similar approach, and found the using portfolios to eliminate some of the errors in the calculation. This is mainly due to the imperfect correlation between stocks, and the portfolio variances declining when there are additional stocks in that portfolio.

2.4 Local CAPM

The local CAPM is defined by the aggregate asset holdings of the all investors within a country. This model assumes that the assets of a country are held by the investors who reside in that country. For example, the beta for UK equities that is listed on the London Stock Exchange would be calculated when it is relative to the value-weighted market return on the London Stock Exchange. Furthermore, the assumption that the assets are only held by individuals who reside in that country, mean that there is no international diversification of risk, and countries' capital markets would totally internationally segmented.

There was a simple empirical test of the CAPM performed on the UK data set by Yurtsever & Zahor (2007). They found evidence for the relationship between the expected return on a security and its risk non-linear for individual securities but no evidence for the portfolios. In addition, they argued that the condition for higher risk is associated with higher expected return and risk aversion is only applicable for securities and not portfolios. Therefore, they could find little evidence for the CAPM model to be used.

2.5 Global CAPM

O'Brien & Dolde (2000) examined a currency global asset pricing model. They argued the currency global capital asset pricing model (CI-CAPM) which included a currency index factor in addition to the global market index could be useful tool for practitioners valuing assets where the markets were globally integrated. Within the model they had taken into account the empirical evidence of the pricing of systematic exposure exchange rate changes, and argued that this provides more depth than the single factor CAPM.

2.6 Local CAPM vs. Global CAPM

One study by Mishra & O'Brien (2001) examined different cost of capital estimates focusing on local and global CAPMs. They found that the cost of equity in US dollars of the single-factor GCAPM differed, on average, from those of the local US-CAPM by 48 basis points for the sample of US stocks used. The developed markets had larger difference than the emerging markets. However, the report concludes that the different models do not make a substantial difference in cost of equity estimates. Nevertheless, the choice of model does make a significant economic difference in the cost of equity estimate for a number of firms.

Furthermore, O'Brien & Dolde (2000) investigated the currency global capital asset pricing model. They examined six techniques to determine the cost of capital for emerging markets. The paper states that there is no consensus of the how to estimate the risk for emerging markets. However, it makes two conclusions; if investors diversify internationally, they should use the international CAPM; but if investors do not diversify internationally, they should use the local CAPM.

A study which appears in many academic books and journals is the Nestle Cost of Equity Capital by Stulz (1995). This study identified that the cost of capital of a small country should be determined globally and not locally. The study identified a pricing error of 0.067 in the beta from using a domestic CAPM rather than the world CAPM, which when implemented with the risk premium would equate to a difference in the global CAPM of 0.42%. Therefore, it was concluded that small countries should use the global CAPM rather than the local CAPM. However, it was mentioned that the study was quite limited and should be expanded.

Another interesting study was performed by Harris, Marston, Mishra, & O'Brien (2003) where they used a proxy for the ex ante expected returns for the global CAPM and domestic CAPM. They compared these with the ex ante expected return estimates and found that the domestic CAPM had a better fit than the global CAPM. However, it was noted that the study found relatively small empirical difference between the two asset pricing models, and that the choice between the two models is not material for most large US companies.

Koedijk, Kool, Schotman, & Van Dijk (2002) analysed the local and global CAPM asset pricing models further. It examined the extent to which the international and domestic asset pricing models implied different estimates for the cost of capital. They distinguished between a multifactor global CAPM and single factor domestic CAPM. The findings from their study were that the domestic CAPM rarely lead to a different estimate for the cost of capital from the multifactor global CAPM, which provide more evidence for the home bias puzzle.

2.7 Integration of Markets

As the world becomes more global and countries become more integrated with each other, there will implications of the world capital markets which will have increasing impacts on financial theory and practice. There have been a number of studies on the integration of global markets, which ranged from international asset pricing models (IAPMs) to integration-segmentation analysis for developing markets. However, tests were sometimes left with inclusive results, while others rejected the integration hypothesis in the developed market in Cho, Eun, & Senbet (1986) study. Whereas, others have found some integration between the certain markets in the past, one study which found support for dual-listing stocks in Canada-US was a study by Alexander, Eun, & Janakiramanan (1987).

Therefore, there have been conflicting and inclusive studies of the integration between the world capital markets. However, there is belief that in global market that integration and coordination between the markets exists. Furthermore, although certain studies might reject the statistical evidence to suggest there is evidence of integration, the markets might still be integrated.

Over the last few decades capital markets have developed and grown substantially, experiencing a large boom in the 1990s. During this process a number of companies raised capital through bonds and equity markets, while the participation in the capital markets from the retail and institutional investors both increased. There was strong growth in the rich countries of the world which was accompanied by an increasing financial integration globally. The extent of the global mobility and capital flows has been around for centuries, but not in the world financial markets. The capital flows tended to be in line with migration.

After World War I, the first blow to the capital markets occurred with a period of instability and crises which led to the Great Depression and World War II. These events led the governments around the world to reverse the financial globalisation and impose capital controls which led to low levels of capital flows in the 1950s and 1960s. The Bretten Woods arrangement of the fixed but adjustable exchange rates dominated the international system, which limited the capital mobility and autonomous monetary policies. However, during the 1970s a new wave of international globalisation occurred in the financial system, mainly as a result from the oil shock and the breakup of the Bretton Woods arrangement of the fixed exchange rates. After this break up the countries were able to open up and increase the capital mobility globally while keeping autonomy in their monetary policies.

In the beginning of the 20th century most of the globalization entailed the rich countries to emerging economies, while most of the recent globalization has occurred between the developed countries. The capital flow between rich countries has increase immensely over the last few decades. (Eichengreen & Sussman, 2000)

The integration should exist when one thinks of the movement over the last few decades and how the formal barriers of trade have decreased and made it is easier for foreign ownership and trade. In addition to the trade barriers decreasing, the largest obstacle to investment has the foreign exchange restrictions, which have also seen significant decreases over the same time period. Also, the ownership rules in many countries have loosened their barriers over the decades making it much easier for foreign ownership to exist. A few decades ago it was not possible for foreigners to own shares within certain country's stock markets, but as this changed quite dramatically over the last few decades; it has made investors global rather than domestic. Having said that there is still a home bias puzzle in existence, but investors are certainly having a proportion of their portfolio invested in foreign stocks.

There have a number of studies focusing around the portfolio holdings of investors with Korajczyk & Viallet (1989) who found evidence that the markets have become more integrated in the 1980s than previously been, and showing signs of integration. This study although slightly dated shows some of the foundations which were set a number of decades ago, and that globalisation has continued throughout the next few decades, and barriers have decreased, which has made integration potentially a more viable prospect. With this in mind it makes it hard to reject the global CAPM model.

There is also evidence to suggest that over the last few decades that the markets have become more integrated and that investor have the potential not only to invest in stocks on a domestic level, but also have the potential to invest on the world market portfolio. This could mean when the local CAPM is used to calculate the cost of capital for investment appraisal could be incorrect, since a key assumption behind this value will be that domestic investors only buy their own home market stocks, and that foreign investors are not able to buy their stock. However, as mentioned earlier the markets have become accessible and domestic investors do purchase in the global market.

The global CAPM could also be argued not to be relevant for countries where there is light foreign ownership and domestic shareholders do not invest abroad. However, there has not been any current evidence to suggest a rejection of this model with time-varying returns. The global CAPM takes into account the fact that integration exists and barriers for foreign investors have been minimised which gives the potential for there to be foreign ownership and with global integration becoming closer over the near term, and with the evidence from the current economic crisis which has impacted all markets not just markets locally, it provides more evidence to suggest that countries are no longer independent entities, especially in the developed world.

3.0 Methodology

3.1 Background to Methodology

The Stulz (1995) study sets out some foundations for testing the international CAPM using Nestle for the as the case analysis. Therefore, to identify the pricing error from using the local CAPM rather than the global CAPM, a larger data sample using similar methodology will be used. However, further analysis will be performed to identify the stock performance and deviation of results in the developed countries around the world and assess the breakdown of the local and global CAPM at an industry level.

3.2 Assumptions

The key assumptions that Stulz (1995) had in place will also be assumed here. These assumptions include that investors rank portfolios, they will prefer a portfolio with greater expected return for a given variance of return, and a portfolio with a lower variance of return for a given return. Furthermore, an assumption is made about the investors that they are sufficiently alike in their preferences and beliefs, and there is only one type of investor per country. These investors are the same across countries in their preferences and beliefs.

In addition, there are more general assumptions which are embedded in the capital asset pricing model which include; investors are risk averse, rational investors seek to hold efficient portfolios, that is, portfolios that are fully diversified. All of the investors have identical investment horizons. All investors have identical expectations about such variables as expected rates of return and how capitalisation rates are generated. There are no transaction costs and no investment-related taxes. The rate received from lending money is the same as the cost of borrowing money. The market has perfect has perfect divisibility and liquidity.

3.3 Local CAPM

Moreover, if we assume that the deviations from the purchasing power parity are not sufficient enough to affect the asset prices, the domestic CAPM can be calculated. This is a traditional model states the cost of equity is estimated as the risk-free rate of interest plus an adjustment for risk, this is equal to the equity's beta multiplied by the market portfolio risk premium. This relationship is shown in equation 1.

Equation 1 - Local CAPM

$$\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$$

Where:

$\bar{R}_{iH}$ = Expected return on shares of firm i, $\bar{R}_{iH}$,

R_F = Return on the local country government's (default-risk-free) debt,

β_{iH} = Covariance between the return of share i, R_i, and the return of the market portfolio of the home country, R_H, divided by the variance of the return of the market portfolio, and

$E(R_H)$ = Expected return of the home country market portfolio

Using Equation 1 the cost of capital will be able to be calculated. However, an assumption within this formula is that it is the home market is isolated from the rest of the world. Also, that the investors in the home country cannot invest abroad and foreign investors cannot invest in the home country.

3.4 Global CAPM

Therefore, in order to calculate the global CAPM an assumption is made that the home market is not isolated and is in fact integrated with the rest of world. This would mean that the home country is integrated in the world capital markets.

Furthermore, the portfolio which minimises the variance of the return for a given expected return for investors of the home country is no longer the market portfolio of that country. The market portfolio is comprised of all markets that are freely accessible for investors of the home country. The single factor global cost of capital can then be calculated using equation 2.

Equation 2 - Global CAPM

$$\bar{R}_{iG} = R_F + \beta_{iG}[E(R_G) - R_F]$$

Where:

$\bar{R}_{iG}$ = Expected return on shares of firm i when markets are global,

R_F = Return on the local country government's (default-risk-free) debt,

β_{iG} = Covariance between the return of share i, R_i, and the return of the market portfolio of the global market, R_G, divided by the variance of the return of the global market portfolio, and

$E(R_G)$ = Expected return of the global market portfolio

Therefore, this will yield the cost of capital where the home country is integrated with the world capital markets. It would be appropriate to say that the local CAPM would not be correct model to use for any market which is not isolated from the capital markets. This paper will be analysing the developed capital markets which would suggest that they are integrated with other world capital markets. Therefore, this paper will focus on the pricing mistakes that could be made by using the local CAPM rather than the global CAPM.

3.5 Local CAPM vs. Global CAPM

When the home country is integrated with the world capital markets, then the expected return on the market portfolio can be derived from the global CAPM, using equation 3:

Equation 3 - Local CAPM vs. Global CAPM

$$E(R_H) = R_F + \beta_{HG}[E(R_G) - R_F]$$

Where:

β_{HG} = Covariance between the return of home country portfolio, and the return of the market portfolio of the global market, R_G, divided by the variance of the return of the global market portfolio

Therefore, the risk premium for the home country can be calculated when the country is integrated in the world capital markets. This allows for the local CAPM model to be developed when the home country is integrated in the world capital markets, by substituting the risk premium into equation 1 to form equation 4:

Equation 4 - Integrated Local CAPM

$$\bar{R}_{iGH} = R_F + \beta_{iH}\beta_{HG}[E(R_G) - R_F]$$

This represents the local CAPM model for a home country which is integrated with the world capital markets.

Stulz (1995) study identified that the in order to determine when the local CAPM was the correct model to use, the local CAPM and global CAPM approaches should give the same answer for the cost of capital. This would occur when $\beta_{iG} = \beta_{iH}\beta_{HG}$.

To calculate the return of the firm i when a component is perfectly correlated with the market portfolio of the home country and a component uncorrelated with that return, is calculated using equation 5:

Equation 5 - Regression for the return correlated with local market portfolio

$$R_i = \alpha_{iH} + \beta_{iH}R_H + \varepsilon_{iH}$$

Where:

α_{iH} = a constant

β_{iH} = Covariance between the return of share i, R_i, and the return of the market portfolio of the home country, R_H, divided by the variance of the return of the market portfolio, and

ε_{iH} = part of the return of the i shares that is uncorrelated

The same approach can be taken to calculate the return of the market portfolio of the home country with a component that is perfectly correlated with the global market portfolio and a component uncorrelated with that return, using equation 6:

Equation 6 - Regression for the return correlated with global market portfolio

$$R_H = \alpha_{HG} + \beta_{HG} R_G + \varepsilon_{HG}$$

Stulz (1995) identified that the global beta could be written as equation 7:

Equation 7 – Stulz (1995) global beta

$$\beta_{iG} = \beta_{iH}\beta_{HG} + covariance(\varepsilon_{iH}, R_G)/variance(R_G)$$

This demonstrated that the two asset pricing models will obtain the same cost of capital only the risk of firm i is uncorrelated with the return of the market portfolio of the home country, ε_{iH} is uncorrelated with the return of the global market portfolio.

Furthermore, a convenient way to summarise the mistake of using the local CAPM rather than the global CAPM is given by equation 8:

Equation 8 - Convenient mispricing formula

$$\bar{R}_{iG} - \bar{R}_{iGH} = \left(\frac{covariance\ (\varepsilon_{iH}, R_G)}{variance\ (R_G)}\right)(E(R_G) - R_F)$$

3.6 Risk parameters

Monthly Returns

In order to calculate the monthly returns, a logarithmic return measure has been used. A lognormal distribution is an asymmetric distribution which is interesting for the modelling distributions for the probability distributions of stock and other assets prices, some of the appealing elements include (Philippe, 2001):

- **The losses on the value of an asset are limited** – If you use a normal distribution for simple gross returns the stock returns could technically lose more than 100% of its value. However, using the lognormal model this is prevented from happening.
- **It can simplify statistical calculations** – The logarithms can calculate multi-period returns by addition rather than multiplication.
- **Logarithms can transform returns from one currency to another**.

Equation 9 - Logarithmic monthly returns

$$r_t = ln\left[\frac{Price_{\,t}}{Price_{\,t-1}}\right]$$

Where:

$Price_t$ = Share price month t

$Price_{t-1}$ = Share price month t-1

Statistical measures

In order to evaluate the stock performance in each country and reliability of the calculated data certain statistical measures will be put in place which include the standard deviation, Jensen's alpha, r-squared and the standard error. The standard deviation, Jensen's alpha and r-squared will measure the strength of the individual stocks price performance compared with the local and global benchmark models.

However, the standard error statistical measure will measure the standard error of the beta calculation for the local and global benchmark on a stock level.

Standard Deviation

It is also interesting to analyse the distribution of returns for individual stock returns as this will provide more information into the dispersion of the average monthly returns. This dispersion will be measured by the standard deviation of the average returns which is given in Equation 10:

Equation 10 - Standard deviation of returns

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})}{n-1}}$$

Where:

x_i = monthly logarithmic return for period i

x = average monthly logarithmic return

n = number of observations

Jensen's Alpha Ratio

This measure is for the portfolio's actual performance compared to its expected performance given the level of risk. The alpha is calculated which is given in Equation 11:

Equation 11 - Jensen's Alpha Ratio

$$\alpha_p = \bar{r}_p - (r_f + \beta_p(\bar{r}_m - r_f))$$

Where:

$\bar{r}_p$ - expected return of the market portfolio

r_f - risk free rate

β_p - Covariance between the return of the portfolio divided by the variance of the return of the market portfolio

$\bar{r}_m$ - expected return of the market

A positive alpha indicates that the portfolio has performed better than expected, whereas a negative figure indicates underperformance.

R-squared

This is a measure which indicates the extent to which fluctuations in portfolio returns are correlated with those of market. This would mean that an R-squared value of 0.60 would imply that 60% of the fluctuations in the portfolio return are explained by the fluctuations in the market. Therefore this can be used to measure the reliability, predictability, and validity of the alpha and beta values. The Equation 12 represents how it is calculated:

Equation 12 - R-Squared

$$r^2 = \frac{(n \sum R_{xi} R_{yi} - \sum R_{xi} \sum R_{yi})^2}{[n \sum (R_{xi})^2 (\sum R_{xi})^2][n \sum (R_{yi})^2 (\sum R_{yi})^2]}$$

Where:

n *– number of observations*

R_{xi} *– market excess return*

R_{yi} *– portfolio excess return*

Standard Error

This is a measure of the probability that sample mean differs from the true population mean. This means that the standard error is a measure of uncertainty due to a sampling or random error and measures how good the mean as a measure of the true mean. The standard error is measured with the using Equation 13:

Equation 13 - Standard Error

$$SE_x = \frac{\sigma}{\sqrt{n}}$$

Where:

$\sigma - is\ the\ standard\ deviation$

n - *is the sample size*

A larger SE means there is more uncertainty in using the sample mean as an estimator of the true (population) mean.

4.0 Data

4.1 Time Horizon

When the beta values are estimated it is important to ensure that the time horizon is not too short as this will make the values unreliable. Furthermore, using very old data will make the current market risk of the security unrepresentative. However, as this is an empirical study and the time period will be twenty years of monthly empirical data. The analytical period for the study is from 1989:01 – 2008:12. The data will be taken on the last trading day of each month.

4.2 Index

To test the effectiveness of the local and the global CAPM models, monthly index value data has been obtained for the twenty developed countries currently in the Morgan Stanley Capital International (MSCI) World Index: Australia, Austria, Belgium, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Kingdom and United States. The MSCI indices have been used to for the local and global markets, while data includes the gross dividend numbers. The data has been obtained from Datastream. Table 1 details the country indices that will be used in the empirical study with a snapshot from 31st December 2008.

Table 1 - MSCI Country Indices[1]

Date	Index Name	Country	Index Value
31-Dec-08	MSCI AUSTRALIA U$ - TOT RETURN IND	AUSTRALIA	2,367.58
31-Dec-08	MSCI AUSTRIA U$ - TOT RETURN IND	AUSTRIA	2,581.07
31-Dec-08	MSCI BELGIUM U$ - TOT RETURN IND	BELGIUM	5,312.58
31-Dec-08	MSCI DENMARK U$ - TOT RETURN IND	DENMARK	10,144.14
31-Dec-08	MSCI FINLAND U$ - TOT RETURN IND	FINLAND	688.96
31-Dec-08	MSCI FRANCE U$ - TOT RETURN IND	FRANCE	4,653.67
31-Dec-08	MSCI GERMANY U$ - TOT RETURN IND	GERMANY	3,971.48
31-Dec-08	MSCI HONG KONG U$ - TOT RETURN IND	HONG KONG	20,925.03
31-Dec-08	MSCI IRELAND U$ - TOT RETURN IND	IRELAND	198.43
31-Dec-08	MSCI ITALY U$ - TOT RETURN IND	ITALY	968.06
31-Dec-08	MSCI JAPAN U$ - TOT RETURN IND	JAPAN	3,770.06
31-Dec-08	MSCI NETHERLANDS U$ - TOT RETURN IND	NETHERLANDS	8,773.34
31-Dec-08	MSCI NORWAY U$ - TOT RETURN IND	NORWAY	4,930.41
31-Dec-08	MSCI PORTUGAL U$ - TOT RETURN IND	PORTUGAL	199.02
31-Dec-08	MSCI SINGAPORE U$ - TOT RETURN IND	SINGAPORE	5,168.87
31-Dec-08	MSCI SPAIN U$ - TOT RETURN IND	SPAIN	3,790.65
31-Dec-08	MSCI SWEDEN U$ - TOT RETURN IND	SWEDEN	11,134.48
31-Dec-08	MSCI SWITZERLAND U$ - TOT RETURN IND	SWITZERLAND	6,905.92
31-Dec-08	MSCI UK U$ - TOT RETURN IND	UK	3,922.25
31-Dec-08	MSCI USA U$ - TOT RETURN IND	USA	3,002.60

4.3 Individual securities

The empirical analysis for the companies with a market capitalisation less than $10 million at the start of the analysis, and which do not have at least 20 years of data are excluded for the study. The study will evaluate at a country and stock level breakdown. This will identify the where the choice of the asset pricing model is significant and the result of using the incorrect model. The sample of individual stocks which have been analysed for each country varies from the United States with 742 stocks to 20 stocks for Ireland. In total 3395 stocks have analysed in the twenty developed countries, Table 2 contains details of the country profiles, with a snapshot taken on 31st December 2008. The important element here was to ensure that the companies which are included in this sample had a sufficient market value to be

[1] The MSCI country indices are taken at 31st December 2008 to illustrate an example of the data which has been collected for the twenty month empirical study. This data is the Total return index in US dollars to ensure consistent data collection.

analysed and that they had consistent trading for the last twenty years. All of the data has been obtained from DataStream including the share price, market capitalisation and ICB details.

Table 2 - Individual stock profiles from the Developed World[2]

Country	No	Average Market Value (USD millions)	No of Sectors
Australia	132	524.49	30
Austria	28	301.37	12
Belgium	44	590.98	18
Denmark	89	237.52	24
Finland	27	268.10	19
France	174	1161.30	34
Germany	260	1027.62	32
Hong Kong	221	243.35	31
Ireland	20	389.10	12
Italy	84	897.26	24
Japan	700	6312.82	33
Netherlands	66	2034.00	24
Norway	29	353.71	14
Portugal	29	110.68	17
Singapore	90	546.54	27
Spain	55	1046.78	23
Sweden	70	350.53	23
Switzerland	108	864.56	25
United Kingdom	427	876.51	39
United States	742	2105.33	37
Mean	3395	1012.13	25

4.4 Risk-free rate

The risk free rate used in the empirical analysis is based on the local government's (default-risk-free) long term debt. The figures were obtained from DataStream and for this analysis the 31st December 2008 data has been used. In some cases it was

[2] Table 2 displays the individual stocks which are represented by each country, containing the total of companies, average market value USD millions, and the number of different industries which have been covered for each country. The snapshot is taken on 31st December 2008.

not possible to find a direct comparison for all countries and in certain circumstances a close substitute has been used, but generally a 10 year government bond has been used, taking either the middle rate or the redemption yield. The index values are displayed in Table 3.

Table 3 - Government debt by Country 31 December 2008[3]

Date	Country	Index Name	Index Value
31-Dec-08	AUSTRALIA	AUSTRALIA BOND YLD. GOVT.10 YR(ECON) - MIDDLE RATE	4.090
31-Dec-08	AUSTRIA	AUSTRIA BENCHMARK BOND 10 YR (DS) - RED. YIELD	3.672
31-Dec-08	BELGIUM	BELGIUM BENCHMARK BOND 10 YR (DS) - RED. YIELD	3.766
31-Dec-08	DENMARK	DENMARK BOND YIELD GOVT.10 YR(ECON) - MIDDLE RATE	3.370
31-Dec-08	FINLAND	FINLAND BENCHMARK BOND 10 YR (DS) - RED. YIELD	3.482
31-Dec-08	FRANCE	FRANCE BENCHMARK BOND 10 YR (DS) - RED. YIELD	3.333
31-Dec-08	GERMANY	GERMANY BENCHMARK BOND 10 YR (DS) - RED. YIELD	2.941
31-Dec-08	HONG KONG	HONG KONG EXCHANGE FUND NOTE 10 YR - RED. YIELD	1.190
31-Dec-08	IRELAND	IRELAND INTERBANK 1 YEAR - OFFERED RATE	3.049
31-Dec-08	ITALY	ITALY BENCHMARK BOND 10 YR (DS) - RED. YIELD	4.363
31-Dec-08	JAPAN	JAPAN BENCHMARK BOND -SYLD.10 YR (DS) - RED. YIELD	1.164
31-Dec-08	NETHERLAND	NETHERLAND BENCHMARK BOND 10 YR (DS) - RED. YIELD	3.528
31-Dec-08	NORWAY	NORWAY INTERBANK 1 YEAR - OFFERED RATE	3.230
31-Dec-08	PORTUGAL	PORTUGAL LISBOR 1 YEAR - OFFERED RATE	3.049
31-Dec-08	SINGAPORE	SINGAPORE T-BOND YIELD 10 YEAR - MIDDLE RATE	2.050
31-Dec-08	SPAIN	SPAIN BENCHMARK BOND 10 YR (DS) - RED. YIELD	3.812
31-Dec-08	SWEDEN	SWEDEN BOND YIELD GOVT.10 YR(ECON) - MIDDLE RATE	2.460
31-Dec-08	SWITZERLAND	SWITZERLAND BOND YD. GOVT.10 YR(ECON) - MIDDLE RATE	1.990
31-Dec-08	UK	UK INTERBANK 1 YEAR - MIDDLE RATE	2.925
31-Dec-08	USA	US TREASURY CONSTANT MATURITIES 10 YR - MIDDLE RATE	2.250

4.5 Equity Risk Premium

When estimating the cost of capital using the two asset pricing models, the significant variable for the risk parameter estimation is the monthly individual equity excess return. This is determined by subtracting the local government's (default-risk-free) long term debt monthly returns from the monthly equity return. For the local CAPM model, this element is the local country MSCI index excess return over the local government's (default-risk-free) long term debt. Whereas, for the global CAPM, the MSCI World Index excess returns over the local government's (default-risk-free)

[3] Table 3 contains the government risk free value for each country, the data has been sourced from DataStream for all the developed countries in this empirical study.

long term debt is the lone variable for this risk parameter. The figures from Table 3 represent the local government default risk.

5.0 Testing

5.1 Risk parameters

In order to identify the extent to which the a pricing error exists with using the local CAPM compared to the global CAPM, the twenty countries will be assessed to identify whether there are characteristics which are prevalent which make the pricing error more significant than for other countries. In order to test this each country will have their sample stocks tests and assess the country profile. Then the key risk parameters will be examined to identify elements of each country which are significantly different between the global and local CAPM. The analysis will focus on the testing the fundamental elements involved in a managers choice for investment. Therefore, it will could tests on the alpha, beta and r-squared. In addition, to identify the reliability of the alpha and beta, the t-statistical analysis will be performed on both these values.

The risk parameters will then be average for each country, to identify the true figure of the country. Each individual stock with the country will be equally weighted to ensure a fair representation of the value and not be skewed towards to the larger firms. The time period of this analysis will be take place is 1989:01 – 2008:12, which is a twenty year coverage period. This should ensure that any anomalies which take place in the market are flattened out, and the results represent fair figures.

In addition, the histograms of the stock returns and standard deviations will be plotted to identify where the stocks in each have a tendency towards, and whether there is a significant deviation in the behaviour of the stocks.

5.2 Local Beta Mispricing

After examining the key risk parameters of the global and local CAPM models it is important to investigate a bit deeper the findings of the Stulz (1995) paper.

Therefore, the local beta mispricing will be re-examined but a on larger scale to the Stulz (1995) study, and will examine all of the 3395 with respective to the country that they belong. The analysis will test the actual mispricing element of using the local CAPM valuation method rather than the global CAPM. This will be examined by comparing the global beta[4] to the global home beta[5].

This will identify each country on average the amount of mispricing that exists between using the local CAPM rather than global CAPM. It also builds on Stulz (1995) study where Nestle was the company used for purpose of the example and this analysis examines 3395 individual stocks in twenty countries of the developed world. Furthermore, when analysing the beta for the global and local index it is important to compare to two values. Therefore, a scatter graph will plot the global and local betas illustrating the relationship between the two values.

In addition, the histograms of the absolute mispricing on a stock level for each country will be plotted. This will identify what the average mispricing for the stocks in a particular country is and the where the peak and skewness exists in the distributed mispricing. Also, it will identify the countries which have an inherent issue with using the local CAPM rather than local CAPM, compared with the countries where the difference is very small.

5.3 Cost of equity estimations

To identify the impact that the beta has on the cost of equity and much it is mispriced, the cost of equity will also be calculated for the asset pricing models using the Fama-French and Stulz risk premium estimates of 3.4% and 5.4% respectively, these are values which they used confirm their findings. This will identify the impact the beta values have directly on the cost of equity measures, with everything else being equal.

---

[4] $(\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$
[5] $\bar{R}_{iGH} = R_F + \beta_{iH}\beta_{HG}[E(R_G) - R_F]$

Firstly, the comparison will take into account the two risk premiums examining the global and local betas directly into the CAPM model and identify the difference which exists between the two models. This will be performed on a country level using the average betas calculated. Next, the global home beta will be used to identify whether this will make a difference to the results and improve the difference between the two countries, or whether the local beta is sufficient.

5.4 Industry Analysis

After the country level has been analysed, it is important to break down the industry which are most affected by the local and global CAPM. To interpret the results is important to take a large country and a smaller country. In this paper the large country which will be analysed will be the United States, whereas the smaller country will be Norway. This will demonstrate the impact of certain industries over time which are most affected. The industries will be based on Industry Classification Benchmark (ICB).

6.0 Results

6.1 Risk parameters

In order to determine the extent at which the global CAPM is better fit than the local CAPM, it is important to analyse the stock performance for each country. Table 4 summarises the average monthly and annual returns and standard deviations, by country for the 3395 stocks which have been analysed. Ten out of the twenty countries had a negative percentage monthly return over the last 20 years, and the other half had positive returns. Japan was the worst performing country, where on average of 700 stocks the monthly return averaged at -0.63%, which equates to an annual average return of -7.53%. However, the United States was the best performing country with average monthly returns of 0.55% across 742 stocks, which equates to 6.64% annual return on average. When analysing the distribution of these returns it can be seen that Hong Kong stocks have the highest standard deviation of 16.72% on monthly average, which equates to an annual standard deviation of returns of 57.92%. However, Belgium has the lowest standard deviation with a value of 9.05%, which equates to 31.36% on an annual basis, almost twice the value of Hong Kong.

In the appendix Figures 8 and 9 contain histograms of the monthly returns and standard deviations for each country analysed in this study. Most of the countries have average returns which are skewed to the left, but six out of the twenty countries are skewed to the right, with the United States and Japan being the most significant countries. Furthermore, the standard deviation histograms for each country’s average return are mostly skewed to the right. Hong Kong has the highest proportion of stocks with the highest volatility, whereas the other countries also have relatively high monthly volatility, with the United States and United Kingdom peaking at 10%, with a significant proportion higher than this. The monthly average return across the twenty developed countries is -0.04%, while the standard deviation is 11.31%.

Table 4 - Key Statistics[6]

Country	No	Monthly Average	Monthly Standard deviation	Annual Average	Annual standard deviation
Australia	132	-0.25%	13.86%	-2.97%	48.03%
Austria	28	-0.08%	9.70%	-1.01%	33.60%
Belgium	44	0.13%	9.05%	1.56%	31.36%
Denmark	89	0.12%	9.53%	1.47%	33.01%
Finland	27	0.33%	9.93%	3.96%	34.40%
France	174	0.03%	10.30%	0.35%	35.68%
Germany	260	-0.29%	10.96%	-3.45%	37.98%
Hong Kong	221	-0.40%	16.72%	-4.83%	57.92%
Ireland	20	-0.02%	12.08%	-0.19%	41.83%
Italy	84	-0.20%	11.00%	-2.39%	38.10%
Japan	700	-0.63%	10.48%	-7.53%	36.32%
Netherlands	66	0.04%	9.34%	0.52%	32.36%
Norway	29	0.23%	12.12%	2.70%	42.00%
Portugal	29	-0.42%	15.17%	-5.04%	52.54%
Singapore	90	-0.14%	11.94%	-1.70%	41.36%
Spain	55	0.12%	10.90%	1.42%	37.77%
Sweden	70	0.23%	11.55%	2.73%	40.01%
Switzerland	108	0.10%	9.28%	1.23%	32.16%
United Kingdom	427	-0.26%	11.95%	-3.15%	41.39%
United States	742	0.55%	10.36%	6.64%	35.90%
Mean	3395	-0.04%	11.31%	-0.48%	39.19%

Furthermore, Table 5 contains analysis of the 3,395 stocks in the twenty developed countries with their respective alpha[7] and beta values for the global[8] and local[9] CAPM models. These are relevant for a manager who will use an asset pricing model to calculate the cost of capital. Twenty countries are analysed and incorporating 3,395 stocks, with the United States, Japan and United Kingdom having the highest representation of stocks. The stocks are analysed over twenty years using monthly share price data.

[6] Table 4 – The original data is monthly equity share prices taken from DataStream for the period 1989:01 – 2008:12. The first column illustrates the number of stocks which have been analysed. The second column contains the mean return for all the stocks in that country. The third column contains the standard deviations of the returns on a monthly basis. The last two columns are calculated annual figures for the return and standard deviation.

[7] $\alpha_p = \bar{r}_p - (r_f + \beta_p(\bar{r}_m - r_f))$

[8] $\bar{R}_{iG} = R_F + \beta_{iG}[E(R_G) - R_F]$

[9] $\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$

The results indicate that using a global index rather than a local index does not have a great impact on the alpha calculation. The alpha calculations are monthly averages and demonstrate a very slight difference in some cases, but when all the countries are averaged over the period, the alpha value is the same to three significant figures, the average of the twenty developed countries is -0.003 for both the local and global CAPM. However, the t-statistic for the alpha is actually marginally smaller for the global index compared with the local index. The global t-statistic is -0.265 while the local t-statistic is -0.297 for the alpha. However, both are still quite low and do not represent a tremendous amount of reliability within the fit to the stocks.

Table 5 - Global and Local CAPM regressions[10]

		Global CAPM					Local CAPM				
Country	No	alpha	t (alpha)	Beta	t (Beta)	R-sqrd	alpha	t (alpha)	Beta	t (Beta)	R-sqrd
Australia	132	-0.005	-0.076	0.628	2.324	0.072	-0.006	-0.249	0.588	1.348	0.100
Austria	28	-0.002	-0.157	0.380	1.214	0.045	-0.002	-0.025	0.448	4.523	0.154
Belgium	44	-0.001	-0.125	0.707	0.194	0.150	-0.001	0.047	0.530	2.622	0.183
Denmark	89	-0.001	0.069	0.467	1.750	0.061	-0.002	-0.149	0.438	-0.100	0.092
Finland	27	0.001	0.138	0.702	1.367	0.101	0.000	0.109	0.377	3.166	0.139
France	174	-0.002	-0.215	0.690	-0.660	0.113	-0.003	-0.304	0.581	-1.786	0.134
Germany	260	-0.005	-0.412	0.496	-1.187	0.069	-0.005	-0.418	0.374	-1.925	0.091
Hong Kong	221	-0.008	-0.584	1.005	-1.897	0.091	-0.011	-0.998	0.890	-8.033	0.227
Ireland	20	-0.004	-0.171	0.881	0.946	0.132	-0.001	0.293	0.717	6.767	0.201
Italy	84	-0.005	-0.746	0.873	-4.655	0.131	-0.005	-0.710	0.797	-7.575	0.262
Japan	700	-0.009	-1.412	0.820	-9.867	0.123	-0.005	-0.725	0.790	-8.036	0.241
Netherlands	66	-0.002	-0.190	0.729	1.650	0.142	-0.003	-0.368	0.597	0.313	0.155
Norway	29	-0.001	-0.032	0.867	0.408	0.118	0.000	0.073	0.605	2.212	0.198
Portugal	29	-0.006	-0.562	0.428	-2.782	0.056	-0.006	-0.522	0.445	-3.924	0.108
Singapore	90	-0.006	-0.676	1.070	-4.458	0.166	-0.005	-0.678	0.923	-8.605	0.365
Spain	55	-0.002	-0.056	0.863	1.556	0.145	-0.004	-0.369	0.678	-1.240	0.209
Sweden	70	-0.001	-0.028	0.886	0.589	0.135	-0.002	-0.129	0.639	-0.160	0.216
Switzerland	108	-0.002	-0.010	0.734	3.124	0.141	-0.004	-0.348	0.562	-0.025	0.115
United Kingdom	427	-0.005	-0.473	0.717	-1.591	0.093	-0.006	-0.523	0.632	-2.117	0.087
United States	742	0.002	0.427	0.832	3.774	0.134	0.000	0.057	0.922	0.914	0.160
Mean	3395	-0.003	-0.265	0.739	-0.410	0.111	-0.003	-0.297	0.627	-1.083	0.172

[10] Table 5 contains the alpha and beta values for the individual stock performance. The alpha value has been calculated using the following equation: $\alpha_p = \bar{r}_p - (r_f + \beta_p(\bar{r}_m - r_f))$, while the beta value has been calculated using $\bar{R}_{iG} = R_F + \beta_{iG}[E(R_G) - R_F]$ and $\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$.

The beta valuations differ quite a bit for the global and local index. Overall the global index has an average beta value of 0.739, while the local index has a beta an average beta of 0.627, which represent a sample of the stocks within each country.
On a country level the beta estimations differ from global to local CAPM from -0.090 to 0.324 for the United States and Finland respectively. Interestingly a lot of the large countries have a smaller difference, with the United Kingdom, Japan and Australia all having a small absolute difference in beta. However, still some of the large European countries have a relatively large difference in beta, with France and Germany having respective differences of 0.108 and 0.122.

The R-squared value for the global and local CAPM was quite different, but both are low, with 11.1% on average for the global index and 17.2% for the local index. Singapore had the highest R-squared value for both the global and local index, with a value of 16.6% for the global index, and rising to 36.5% for the local index. However, the lowest R-squared value was for Austria in the global index with a value of only 4.5%, while the lowest for the global index was the United Kingdom with a value of 8.7%.

6.2 Local Beta Mispricing

In the study from Stulz (1995) a mistake in the estimation of a firm's beta in case of the domestic CAPM rather than the international CAPM was derived, and resulted in pricing error. The Stulz (1995) study looked at Nestle as example of the pricing error which exists. Therefore, Table 6 builds on this study to evaluate the twenty developed countries within the MSCI World Index. Stulz (1995) found the cost of capital for the domestic CAPM to be significantly different from the international CAPM. The analysis included in Table 6 contains the breakdown by country with the global, local and global home beta values to calculate the mispricing error of using the local CAPM. The stocks from each country are evaluated to form the values of each country and the average value is used.

An important element of the Stulz (1995) study was the difference between the global beta[11] and global home beta[12] which leads to a pricing error within the calculation of the cost of capital. Table 6 summarises the pricing error which exists for each of the twenty developed countries within this study. Given that during the period of study international integration within the markets exists, there would be an expectation for the difference in the local CAPM and the global CAPM to be small on average. All of the stocks within each country with have been selected are domestic stocks with over 20 years of trading, and represent a broad spectrum of stocks within that country which should provide an objective view of the correlation of the stocks.

Therefore when analysing Table 6, it can summarised that using the local CAPM will underestimate the riskiness of the stocks. This is due to a number of countries which have stock markets which are open with limited barriers to entry for investment especially in the developed world, which means that the stocks would have the potential to be exposed to international risks outside their home market. This means when the risk of the stock is only assessed with local market the risk will be limited and will not represent the true riskiness that the stock is exposed to. The beta that should be used for the averaged stocks in the developed world should be 0.739, which is relative to the MSCI world index, and instead 0.673 is used. This is of course an average for all the countries and results in an underestimate of 0.066, which is smaller than the Stulz (1995) Nestle case example which had a value of -0.093.

Furthermore, each country has a large variation in the mispricing valuation of the beta. Switzerland actually has the largest mispricing error when 108 stocks are analysed. The beta would be understated by 0.270 if the local CAPM was used to compare the global CAPM. This is also in contrast to the Stulz (1995) study where Nestle, a Swiss company actually overstated the riskiness. In contrast Portugal had the lowest mispricing error with an underestimation of 0.004. The United States had a relatively low mispricing error of 0.029 and had the largest sample size. However,

[11] $(\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$

[12] $\bar{R}_{iGH} = R_F + \beta_{iH}\beta_{HG}[E(R_G) - R_F]$

since the global index has a high representation of American stocks, I suspect this is not so surprising.

Table 6 - Mispricing of CAPM[13]

Country	No	Global Beta	Local Beta	Global Home Beta	Local x Global Home Beta	Mispricing
Australia	132	0.628	0.588	0.946	0.556	0.071
Austria	28	0.380	0.448	1.001	0.448	-0.068
Belgium	44	0.707	0.530	1.058	0.560	0.146
Denmark	89	0.467	0.438	0.945	0.414	0.053
Finland	27	0.702	0.377	1.399	0.528	0.174
France	174	0.690	0.581	1.062	0.617	0.072
Germany	260	0.496	0.374	1.186	0.443	0.053
Hong Kong	221	1.005	0.890	1.089	0.970	0.035
Ireland	20	0.881	0.717	1.088	0.780	0.101
Italy	84	0.873	0.797	0.994	0.792	0.082
Japan	700	0.820	0.790	1.047	0.827	-0.007
Netherlands	66	0.729	0.597	1.069	0.638	0.092
Norway	29	0.867	0.605	1.268	0.768	0.100
Portugal	29	0.428	0.445	0.952	0.423	0.004
Singapore	90	1.070	0.923	1.166	1.076	-0.006
Spain	55	0.863	0.678	1.196	0.812	0.052
Sweden	70	0.886	0.639	1.421	0.909	-0.023
Switzerland	108	0.734	0.562	0.825	0.464	0.270
United Kingdom	427	0.717	0.632	0.893	0.564	0.153
United States	742	0.832	0.922	0.870	0.803	0.029
Total	3395	0.739	0.627	1.074	0.673	0.066

The United Kingdom on the other hand would have thought to be similar to the United States with a high representation in the world index, and therefore a small mispricing error from using the local CAPM compared with the global CAPM, but the actual error is quite large at 0.153 underestimate.

Interestingly, only four of the twenty countries actually overstate the riskiness in the stocks when using the local CAPM. These points to evidence to suggest that the local

[13] Table 6 contains the methodology from the Stulz (1995) of the Nestle case. The data set is monthly return data for the twenty countries and 3,395 stocks and the mispricing of the local CAPM model using the following formula: $\bar{R}_{iG} = R_F + \beta_{iG}[E(R_G) - R_F]$, $\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$, $\bar{R}_{iGH} = R_F + \beta_{iH}\beta_{HG}[E(R_G) - R_F]$. The mispricing is the difference between the global beta and the local x global home beta.

CAPM is actually conservative measure of the riskiness, unlike the Nestle case, where there was an overstatement.

Furthermore, in the appendix Figure 8 compares the global and local beta by country for the 3395 stocks in twenty countries. The figures provide scatter plot of the global beta versus the local beta. These histograms tend to demonstrate that there is a tendency for the countries to be closer to their global beta for the larger countries such as the United States and United Kingdom, whereas some of the countries are closer to the local beta, like Austria, Ireland and Italy. However, each of the individual stocks is plotted on the scatter chart and there does not tend to be a significant pattern to which the individual stocks are closer to. All of the scatter plots and quite evenly distributed with only a few outliers on each country.

In addition, also in the appendix in Figure 9 are histograms of the mispricing errors on a stock level, demonstrating where that the skewness is quite evenly split between the right and left side. Furthermore, in most cases the peak of the histogram is higher than zero with Austria, Finland, Hong Kong, Japan and Sweden have their peak value at zero, with all apart from Austria being skewed to the right.

6.3 Cost of equity estimations

The cost of equity estimations for the stocks in the selected developed world are summarised in Table 7. There are 3395 stocks from twenty elected countries within the MSCI World index. The risk free rate of each country is summarised in Table 3, taking the index valuation on 31 December 2008. There are also two estimates of the global market risk premium being used to compare the global and local CAPM models. The two equity risk premiums which are used are the Fama-French (2000) and Stulz (1995b) studies which used respective values of 3.40% and 5.40% for the risk premium to support their findings. These values will help to establish the extent that the global and local CAPM models differ on a broad base of stocks. These two values are theoretical figures used only establish the difference that can exist.

Furthermore, the beta values with their respective standard errors are summarised in Table 7. It is interesting to note that Austria has lowest standard error when the global index is used with a value of 0.380, while Finland has the lowest standard error when the local index is used with a value of 0.063. In contrast Hong Kong has the largest standard error when the global index is used with a value of 0.245, while the United Kingdom had the largest error when the local index was used with a value of 0.166.

Table 7 - Cost of equity estimates of stocks by developed countries[14]

			Global CAPM				Local CAPM			
Country	No	Risk Free Rate	Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%	Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%
Australia	132	4.090	0.628	0.206	6.22	7.48	0.588	0.157	6.09	7.26
Austria	28	3.672	0.380	0.145	4.97	5.73	0.448	0.080	5.19	6.09
Belgium	44	3.766	0.707	0.128	6.17	7.58	0.530	0.086	5.57	6.63
Denmark	89	3.370	0.467	0.141	4.96	5.89	0.438	0.106	4.86	5.74
Finland	27	3.482	0.702	0.143	5.87	7.27	0.377	0.063	4.77	5.52
France	174	3.333	0.690	0.148	5.68	7.06	0.581	0.115	5.31	6.47
Germany	260	2.941	0.496	0.162	4.63	5.62	0.374	0.107	4.21	4.96
Hong Kong	221	1.190	1.005	0.245	4.61	6.62	0.890	0.128	4.22	6.00
Ireland	20	3.049	0.881	0.173	6.05	7.81	0.717	0.112	5.49	6.92
Italy	84	4.363	0.873	0.157	7.33	9.08	0.797	0.093	7.07	8.67
Japan	700	1.164	0.820	0.150	3.95	5.59	0.790	0.093	3.85	5.43
Netherlands	66	3.528	0.729	0.133	6.01	7.47	0.597	0.103	5.56	6.75
Norway	29	3.230	0.867	0.175	6.18	7.91	0.605	0.093	5.29	6.50
Portugal	29	3.049	0.428	0.227	4.50	5.36	0.445	0.150	4.56	5.45
Singapore	90	2.050	1.070	0.167	5.69	7.83	0.923	0.084	5.19	7.03
Spain	55	3.812	0.863	0.155	6.75	8.47	0.678	0.098	6.12	7.47
Sweden	70	2.460	0.886	0.165	5.47	7.24	0.639	0.088	4.63	5.91
Switzerland	108	1.990	0.734	0.131	4.49	5.95	0.562	0.120	3.90	5.03
United Kingdom	427	2.925	0.717	0.174	5.36	6.80	0.632	0.166	5.07	6.34
United States	742	2.250	0.832	0.147	5.08	6.74	0.922	0.147	5.39	7.23
Mean	3395	2.986	0.739	0.164	5.497	6.975	0.627	0.110	5.116	6.370

[14] Table 7 contains the risk free data which are from Table 3, the beta values are calculated using the following formulas: $\bar{R}_{iG} = R_F + \beta_{iG}[E(R_G) - R_F]$, $\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$. The Fama-French 3.4% and Stulz 5.4% are risk premiums used to demonstrate the difference between the global and local CAPM models.

The differences between the Global and local CAPM are quite significant with the Fama-French and Stulz risk premium values. The average CAPM value for the global index is 5.497% and 6.975% respectively. This is compared with 5.116% and 6.370% respective values for the local CAPM. However, when analysing these figures in more detail it becomes clear that certain countries have a higher tendency to have a larger difference with these cost of capital measures. The largest difference occurs for Finland which has respective differences of 1.103 and 1.752, which is quite considerable, but the beta of the local CAPM is almost half the global CAPM. Whereas the smallest difference occurs for the Portugal stocks, where there are respective differences of -0.058 and -0.092, which are very similar values.

However, when the Stulz global home beta[15] which is from the Stulz (1995)study and determined that the difference between this value and the global beta should be the same when a local country is integrated with the world markets. The difference between the cost of equity estimations becomes larger, the results are summarised in Table 8. The difference between the two measures is now 1.139 and 1.809 respectively for the Fama-French and Stulz risk premium values. Therefore, previously only three out of twenty countries had larger value for the local CAPM, whereas now they are all higher with the local CAPM. Finland went from having the largest positive difference to having the largest negative difference. However, the United States has the smallest difference between the global and local CAPM, with very similar values.

The 3395 stocks in twenty countries have been summarised in Table9 displaying their absolute difference in the cost of equity for each country. The average mean and standard deviation of the difference is significant different between the Fama-French and Stulz risk premium figures. The mean difference for all the countries using the Fama-French risk premium is 55 basis points compared with 88 basis points when using the Stulz figure. Furthermore, the standard deviation of the difference is

[15] $\bar{R}_{iGH} = R_F + \beta_{iH}\beta_{HG}[E(R_G) - R_F]$

41 basis points for the Fama-French risk premium, while it is 65 basis points for the Stulz figure.

Table 8 - Cost of equity estimates (Global Home Beta)[16]

			Global CAPM				Local CAPM			
Country	No	Risk Free Rate	Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%	Global Home Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%
Australia	132	4.090	0.628	0.206	6.22	7.48	0.946	0.157	7.31	9.20
Austria	28	3.672	0.380	0.145	4.97	5.73	1.001	0.080	7.08	9.08
Belgium	44	3.766	0.707	0.128	6.17	7.58	1.058	0.086	7.36	9.48
Denmark	89	3.370	0.467	0.141	4.96	5.89	0.945	0.106	6.58	8.48
Finland	27	3.482	0.702	0.143	5.87	7.27	1.399	0.063	8.24	11.03
France	174	3.333	0.690	0.148	5.68	7.06	1.062	0.115	6.94	9.07
Germany	260	2.941	0.496	0.162	4.63	5.62	1.186	0.107	6.97	9.34
Hong Kong	221	1.190	1.005	0.245	4.61	6.62	1.089	0.128	4.89	7.07
Ireland	20	3.049	0.881	0.173	6.05	7.81	1.088	0.112	6.75	8.92
Italy	84	4.363	0.873	0.157	7.33	9.08	0.994	0.093	7.74	9.73
Japan	700	1.164	0.820	0.150	3.95	5.59	1.047	0.093	4.72	6.82
Netherlands	66	3.528	0.729	0.133	6.01	7.47	1.069	0.103	7.16	9.30
Norway	29	3.230	0.867	0.175	6.18	7.91	1.268	0.093	7.54	10.08
Portugal	29	3.049	0.428	0.227	4.50	5.36	0.952	0.150	6.28	8.19
Singapore	90	2.050	1.070	0.167	5.69	7.83	1.166	0.084	6.01	8.34
Spain	55	3.812	0.863	0.155	6.75	8.47	1.196	0.098	7.88	10.27
Sweden	70	2.460	0.886	0.165	5.47	7.24	1.421	0.088	7.29	10.14
Switzerland	108	1.990	0.734	0.131	4.49	5.95	0.825	0.120	4.80	6.45
United Kingdom	427	2.925	0.717	0.174	5.36	6.80	0.893	0.166	5.96	7.75
United States	742	2.250	0.832	0.147	5.08	6.74	0.870	0.147	5.21	6.95
Mean	3395	2.986	0.739	0.164	5.497	6.975	1.074	0.110	6.636	8.784

Finland has the largest difference in basis points between the local and global CAPM with 110 basis point difference with Fama-French and 175 basis points with Stulz. It also has the largest standard deviation for both measures. Denmark has the lowest average difference between the local and global CAPM with 28 and 45 basis points for Fama-French and Stulz respectively. However, the United Kingdom and United States also have relatively low differences.

[16] Table 8 is the same as Table 7, apart from the global home beta is used, with the following formula: $\bar{R}_{iGH} = R_F + \beta_{iH}\beta_{HG}[E(R_G) - R_F]$.

Table 9 - Cost equity absolute difference by country[17]

		Fama-French 3.4% Local CAPM / Global		Stulz 5.4% Local CAPM / Global	
Country	No	Mean	StDev	Mean	StDev
Australia	132	49	48	78	77
Austria	28	31	30	50	48
Belgium	44	60	33	96	53
Denmark	89	28	20	45	32
Finland	27	110	66	175	105
France	174	41	31	66	50
Germany	260	48	35	75	55
Hong Kong	221	63	53	99	85
Ireland	20	61	59	97	78
Italy	84	42	40	67	63
Japan	700	42	38	66	60
Netherlands	66	45	31	72	49
Norway	29	94	59	150	94
Portugal	29	40	35	64	55
Singapore	90	54	41	85	66
Spain	55	66	37	105	59
Sweden	70	86	43	136	69
Switzerland	108	64	57	102	90
United Kingdom	427	40	36	64	57
United States	742	37	28	59	45
Mean		55	41	88	65

Figure 2 illustrates the histogram of the basis point absolute differences for the 3395 stocks in each country when using the Fama-French 3.4% risk premium value. A large number of stocks actually have a relatively small difference between the local and global CAPM models. However, there are significant number which do have a large difference, and it can be seen the majority have a value greater 40 basis points, which could be quite significant in the valuation of a project. Furthermore, 444 out of the 3395 stock in the sample have an absolute difference which is greater than 100 basis points, which is quite a significant difference.

[17] Table 9 contains the absolute difference between the global and local CAPM. The mean and standard deviation represents the average absolute difference for each stock in the respective country between global and local CAPM for the Fama-French and Stulz risk premium values. The numbers are displayed in basis points.

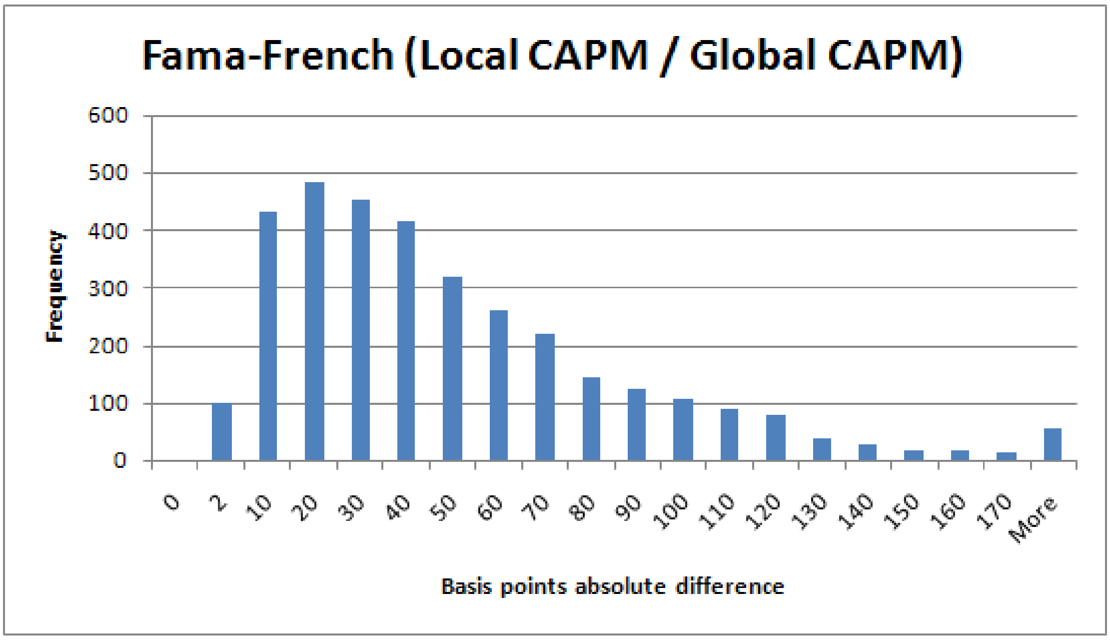


Figure 2 - Cost of equity absolute difference Fama-French[18]

Figure 3 illustrates the histogram of the absolute differences between when the local and global CAPM when using the Stulz risk premium figure. The histogram represents the difference of the 3395 stocks in twenty countries. It appears that a large proportion of the stocks have an absolute difference between 15 to 60 basis points. However, there are also a considerable number of stocks with very basis point differences which demonstrates that it can really make a significant difference to the cost of equity for a project calculation. In addition, there are 498 stocks out of the 3395 in the sample which have an absolute difference which is greater than 150 basis points.

[18] Figure 2 is a histogram of the absolute differences between the global and local CAPM for the 3,395 stocks in the twenty countries for the Fama-French 3.4% risk premium.

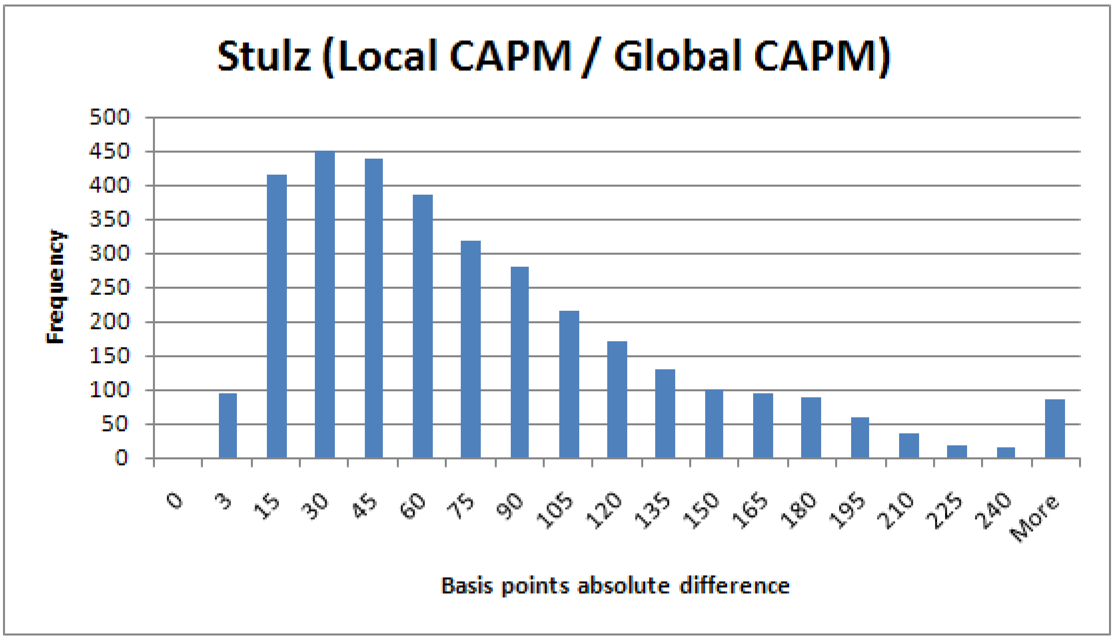


Figure 3 - Cost of equity absolute difference Stulz[19]

If the two absolute differences are looked at together there are 1048 stocks out of the 3395 which have an absolute difference of more than 120 basis points, which represents 15.4% of the sample. This highlights the significance of using the correct measuring tool. Therefore, this would highlight that is not really the country which makes the difference in the pricing error but there could actually be other factors which are playing role in the mispricing of the local CAPM, especially for the stocks which have a difference which is greater than 240 basis points. This would make a very significant difference when evaluating the cost of capital for a project or investment decision.

6.4 Industry Analysis

6.4.1 United States

The estimated risk parameters for the global and local CAPM in the United States are summarised by industry in Tables 10 and 11, with their corresponding standard

[19] Figure 3 is a histogram of the absolute differences between the global and local CAPM for the 3,395 stocks in the twenty countries for the Stulz 5.4% risk premium.

errors, and cost equity estimations for the Fama-French and Stulz risk premiums. When the United States 742 companies are broken down by industry they have an average global beta of 0.836 compared to an average local beta of 0.919. However, although there is a slight difference in the value, the standard error of the betas is almost identical with the local beta being 0.001 larger than the global beta.

The difference in beta values between the global and local CAPM has an impacted when using the Fama-French and Stulz risk premium estimations. The global CAPM produces average cost of equity of 5.09% and 6.77% respectively, while the local CAPM has slightly larger estimations of 5.38% and 7.21% respectively.

The actual differences between the industries is some cases very small, especially Industrial Metals & Mining which has an identical global and local beta estimation and consequently the same cost of equity measure for both the Fama-French and Stulz risk premiums. Whereas Technology Hardware & Equipment has the largest difference in beta estimation with the difference between the global and local CAPM being 0.182 which impact the cost of equity estimations quite considerably with the Stulz measure being over one percent greater as a result.

Furthermore, in order to identify the industries in more detail for the 742 stocks in the United States it is very insightful to analyse the absolute difference between the global and local CAPM models, these values are summarised in Tables 12 and 13. The average differences for all of the industries was 36 and 57 basis points respectively for the Fama-French and Stulz risk premiums, while the standard deviations for were 23 and 37 basis points respectively.

Table 10 - Cost of equity estimates of United States stocks by industry[20]

Indsutry	No	Risk Free Rate	Global CAPM Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%	Local CAPM Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%
Aerospace & Defense	16	2.25	0.804	0.140	4.984	6.593	0.866	0.142	5.196	6.928
Automobiles & Parts	10	2.25	0.982	0.149	5.587	7.550	1.094	0.148	5.971	8.159
Banks	57	2.25	0.521	0.119	4.020	5.061	0.666	0.117	4.514	5.846
Beverages	8	2.25	0.610	0.132	4.324	5.544	0.714	0.133	4.678	6.106
Chemicals	30	2.25	0.783	0.131	4.912	6.478	0.826	0.133	5.058	6.710
Construction & Materials	16	2.25	0.879	0.138	5.240	6.999	0.954	0.138	5.493	7.400
Electricity	36	2.25	0.405	0.101	3.626	4.435	0.436	0.102	3.731	4.603
Electronic & Electrical Equipment	35	2.25	1.123	0.163	6.069	8.316	1.201	0.164	6.332	8.734
Financial Services (Sector)	17	2.25	1.073	0.151	5.899	8.045	1.241	0.147	6.468	8.950
Fixed Line Telecommunications	7	2.25	0.913	0.137	5.353	7.179	1.020	0.136	5.718	7.758
Food & Drug Retailers	11	2.25	0.644	0.135	4.439	5.726	0.736	0.136	4.752	6.224
Food Producers	19	2.25	0.525	0.122	4.036	5.087	0.614	0.123	4.338	5.566
Forestry & Paper	2	2.25	0.821	0.125	5.042	6.684	0.955	0.124	5.498	7.408
Gas, Water & Multiutilities	28	2.25	0.343	0.093	3.416	4.101	0.357	0.094	3.463	4.177
General Industrials	20	2.25	0.903	0.117	5.321	7.127	0.990	0.116	5.617	7.597
General Retailers	35	2.25	0.936	0.170	5.433	7.305	1.079	0.169	5.920	8.078
Health Care Equipment & Services	33	2.25	0.680	0.169	4.563	5.924	0.742	0.171	4.774	6.258
Household Goods & Home Construction	27	2.25	0.794	0.145	4.950	6.539	0.951	0.144	5.482	7.383
Industrial Engineering	33	2.25	0.961	0.136	5.518	7.440	1.010	0.137	5.683	7.702
Industrial Metals & Mining	7	2.25	1.170	0.144	6.226	8.566	1.170	0.147	6.227	8.567

[20] Table 10 & 11 represent the 742 stocks within the United States sample for the twenty year empirical study. The stocks are broken down into industries in the ICB classification system and the average valuation is calculated. The beta values are calculated using the following formulas: $\bar{R}_{iG} = R_F + \beta_{iG}[E(R_G) - R_F]$, $\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$. The risk premiums from Fama-French and Stulz are used again to demonstrate the difference in the global and local CAPM.

Table 11 - Cost of equity estimates of United States stocks by industry (cont)

			Global CAPM				Local CAPM			
Indsutry	No	Risk Free Rate	Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%	Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%
Industrial Transportation	17	2.25	0.811	0.132	5.006	6.627	0.902	0.132	5.315	7.118
Leisure Goods	9	2.25	0.994	0.166	5.629	7.617	1.093	0.167	5.966	8.152
Life Insurance	6	2.25	0.935	0.139	5.430	7.301	1.067	0.137	5.877	8.011
Media	14	2.25	0.871	0.114	5.210	6.951	0.979	0.113	5.579	7.538
Mining	4	2.25	0.935	0.198	5.430	7.301	0.832	0.204	5.080	6.745
Mobile Telecommunications	2	2.25	1.118	0.139	6.052	8.288	1.214	0.139	6.377	8.804
Nonlife Insurance	22	2.25	0.560	0.127	4.154	5.274	0.698	0.127	4.624	6.020
Oil & Gas Producers	21	2.25	0.784	0.152	4.916	6.485	0.688	0.157	4.591	5.968
Oil Equipment & Services	17	2.25	1.132	0.167	6.099	8.363	1.072	0.172	5.895	8.038
Personal Goods	14	2.25	0.870	0.156	5.208	6.948	0.981	0.156	5.586	7.548
Pharmaceuticals & Biotechnology	20	2.25	0.799	0.173	4.966	6.564	0.914	0.174	5.359	7.188
Real Estate Investment Trusts	20	2.25	0.506	0.121	3.970	4.982	0.561	0.123	4.158	5.280
Software & Computer Services	20	2.25	1.236	0.206	6.451	8.922	1.399	0.205	7.006	9.804
Support Services	32	2.25	0.757	0.148	4.824	6.337	0.836	0.149	5.094	6.767
Technology Hardware & Equipment	56	2.25	1.456	0.216	7.199	10.111	1.645	0.214	7.841	11.130
Tobacco	2	2.25	0.420	0.128	3.679	4.520	0.524	0.129	4.032	5.080
Travel & Leisure	19	2.25	0.893	0.173	5.286	7.072	0.983	0.174	5.592	7.558
Mean	**742**	**2.25**	**0.836**	**0.145**	**5.094**	**6.767**	**0.919**	**0.146**	**5.375**	**7.214**

Table 12 - Cost of equity absolute difference United States stocks by industry[21]

		Fama-French 3.4% Local CAPM / Global		Stulz 5.4% Local CAPM / Global	
Indsutry	No	Mean	St Dev	Mean	St Dev
Aerospace & Defense	16	23	22	36	35
Automobiles & Parts	10	40	20	64	32
Banks	57	51	29	80	46
Beverages	8	44	59	70	93
Chemicals	30	23	14	36	22
Construction & Materials	16	29	24	46	38
Electricity	36	17	13	27	21
Electronic & Electrical Equipment	35	29	20	46	32
Financial Services (Sector)	17	57	38	91	60
Fixed Line Telecommunications	7	36	21	58	33
Food & Drug Retailers	11	32	18	51	29
Food Producers	19	33	22	53	34
Forestry & Paper	2	46	19	72	30
Gas, Water & Multiutilities	28	11	8	18	12
General Industrials	20	30	20	47	32
General Retailers	35	50	28	80	44
Health Care Equipment & Services	33	29	20	46	31
Household Goods & Home Construction	27	53	28	84	44
Industrial Engineering	33	22	16	35	26
Industrial Metals & Mining	7	21	13	34	20

However, when analysing the industries in more detail it appears that the Technology Hardware & Equipment industry has the largest difference between the global and local CAPM over the last twenty years. The difference for this industry with the Fama-French and Stulz risk premiums is 67 and 106 basis points respectively. However, the largest standard deviation appears for the Beverages industry, but this mainly due to one outlier of Hansen Natural which has a difference of 181 and 288 basis points for the Fama-French and Stulz risk premiums. In contrast, the Gas, Water & Multiutilities industry has the lowest mean and standard deviation of differences between the global and local values with 11 and 18 basis point difference for Fama-French and Stulz respectively, while having a standard deviation of 8 and 12 basis points.

[21] Table 12 & 13 represent the 742 stocks within the United States sample for the twenty year empirical study. The stocks are broken down into industries in the ICB classification system and the average valuation is calculated. The absolute difference between the global and local CAPM are calculated. The mean and standard deviation represents the average absolute difference for each stock in the respective industry between global and local CAPM for the Fama-French and Stulz risk premium values. The numbers are displayed in basis points.

Table 13 - Cost of equity absolute difference United States stocks by industry (cont)

		Fama-French 3.4% Local CAPM / Global		Stulz 5.4% Local CAPM / Global	
Indsutry	No	Mean	St Dev	Mean	St Dev
Industrial Transportation	17	31	23	50	36
Leisure Goods	9	34	14	53	22
Life Insurance	6	45	33	71	52
Media	14	37	17	59	26
Mining	4	35	27	56	43
Mobile Telecommunications	2	32	27	52	42
Nonlife Insurance	22	47	20	75	32
Oil & Gas Producers	21	33	29	52	45
Oil Equipment & Services	17	26	17	41	27
Personal Goods	14	41	30	65	47
Pharmaceuticals & Biotechnology	20	44	22	69	35
Real Estate Investment Trusts	20	24	18	37	29
Software & Computer Services	20	58	33	92	53
Support Services	32	33	23	52	37
Technology Hardware & Equipment	56	67	38	106	60
Tobacco	2	35	18	56	29
Travel & Leisure	19	36	24	58	38
Mean	742	36	23	57	37

Figure 4 presents a histogram of the basis point absolute differences between the local and global CAPM when using the Fama-French. It can be seen that the 742 companies have quite different estimations of their cost of equity, with the peak of differences between 25 and 35 basis points. However, there are a number of companies that have difference between the local and global CAPM above 100 basis points which is quite substantial.

Furthermore, if the Stulz risk premium estimation is used these differences are enlarged. Figure 5, presents the United States estimations for the Stulz risk premium, and it can be seen that there are a number of companies out of the 742 United States companies which have a very large difference. However, there are still a lot of companies where the difference between the local and global is marginally smaller.

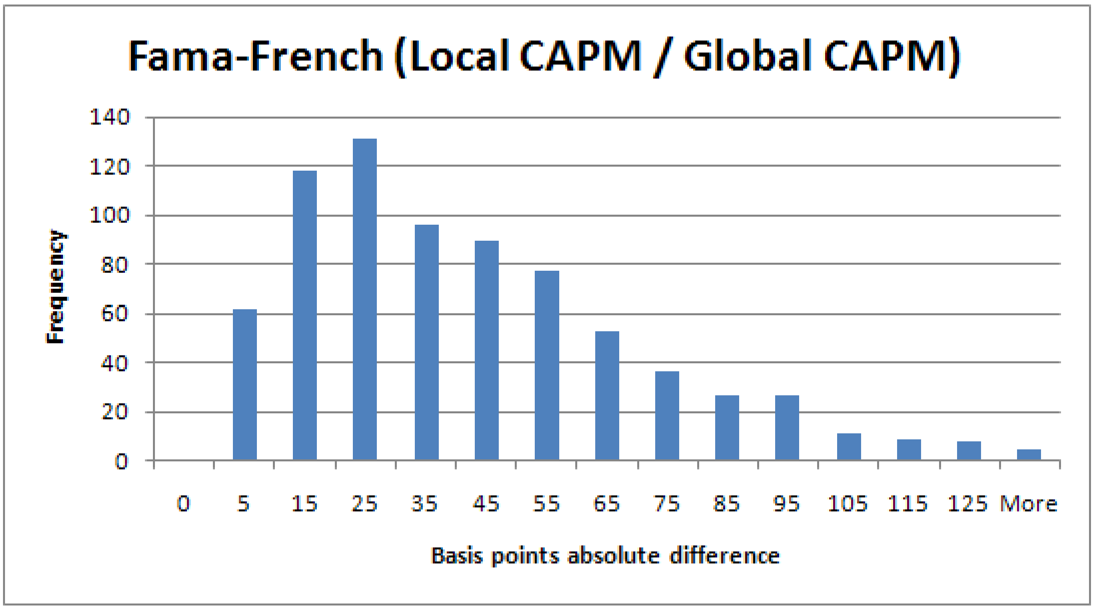


Figure 4 - Cost of equity absolute difference Fama-French: United States[22]

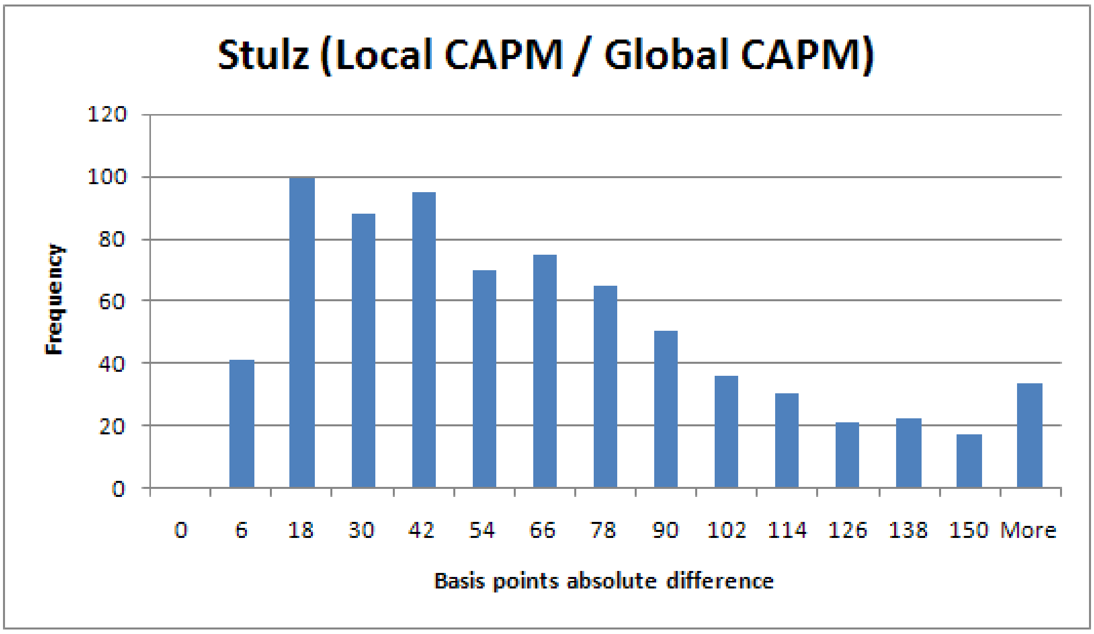


Figure 5 - Cost of equity absolute difference Stulz: United States

6.4.2 Norway

However, to get a different perspective for a smaller country, Norway has also been analysed, with the results detailed in Table 14. It could be seen in the United States

[22] Figure 4 & 5shows a histogram of the absolute differences between the global and local CAPM for the 742 stocks in the United States for the Fama-French and Stulz risk premiums.

study that the results between the global and local CAPM was relatively small, whereas in Norway these differences are quite large. The sample of the stocks in Norway is only 29, but it can be seen when that the average beta for all the industries are 0.881 and 0.636 respectively for the global and local CAPM. These two values are quite significantly different and make quite a large difference for the Fama-French and Stulz risk premiums, which could impact a decision made by a manager when deciding whether to purpose a project or not.

Then analysing the Norwegian stocks in more detail, it is interesting to note that the Financial Services (Sector) has the lowest difference between the global and local values, although the sample only includes one stock which is Skiens Aktiemolle. Whereas, the Life Insurance industry appears to have the largest difference in beta value between the global and local CAPM, and again only includes one stock which is Storebrand.

Furthermore, it is interesting to note that the standard error of the local CAPM is 0.090 which is a lot smaller than the standard error of the global CAPM which is 0.171. In addition, it appears that in every industry the local CAPM has a substantially lower standard error than the global CAPM. This could be due to the integration of Norwegian market over the last twenty years. Perhaps their integration has been more limited in the longer term.

Table 14 - Cost of equity estimates of Norway stocks by industry[23]

			Global CAPM				Local CAPM			
Indsutry	No	Risk Free Rate	Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%	Beta	se (Beta)	Fama-French 3.4%	Stulz 5.4%
Construction & Materials	1	3.23	0.890	0.133	6.256	8.036	0.576	0.071	5.187	6.338
Electricity	2	3.23	0.858	0.121	6.147	7.863	0.553	0.064	5.111	6.217
Financial Services (Sector)	1	3.23	0.367	0.090	4.477	5.210	0.342	0.047	4.391	5.074
Food Producers	2	3.23	0.728	0.112	5.706	7.163	0.535	0.056	5.047	6.117
Industrial Engineering	3	3.23	0.956	0.237	6.481	8.393	0.528	0.131	5.026	6.083
Industrial Metals & Mining	1	3.23	1.015	0.109	6.681	8.711	0.885	0.040	6.238	8.007
Industrial Transportation	9	3.23	0.759	0.177	5.810	7.328	0.510	0.096	4.964	5.983
Life Insurance	1	3.23	1.695	0.168	8.992	12.382	1.080	0.086	6.902	9.063
Media	1	3.23	0.226	0.157	3.999	4.452	0.129	0.087	3.669	3.927
Oil & Gas Producers	1	3.23	0.643	0.298	5.416	6.702	0.872	0.157	6.195	7.939
Oil Equipment & Services	3	3.23	1.022	0.152	6.703	8.747	0.816	0.075	6.005	7.637
Real Estate Investment & Services	1	3.23	0.645	0.120	5.422	6.712	0.508	0.062	4.959	5.976
Software & Computer Services	2	3.23	1.212	0.251	7.352	9.776	0.791	0.137	5.920	7.503
Technology Hardware & Equipment	1	3.23	1.313	0.263	7.693	10.318	0.782	0.145	5.890	7.455
Mean	**29**	**3.23**	**0.881**	**0.171**	**6.224**	**7.985**	**0.636**	**0.090**	**5.393**	**6.666**

Since there are only 29 companies within the sample for Norway, it would not useful to produce any information of the average absolute difference and standard deviations of the differences between the local and global CAPM. However, figures 6 and 7 present the histograms of the absolute differences using the risk premiums from Fama-French and Stulz. It can be seen that although a few companies have a small difference between the local and global CAPM, there is a substantial number of companies which have a very large difference.

[23] Table 14 represents the 29 stocks within Norway in the sample for the twenty year empirical study. The stocks are broken down into industries in the ICB classification system and the average valuation is calculated. The beta values are calculated using the following formulas: $\bar{R}_{iG} = R_F + \beta_{iG}[E(R_G) - R_F]$, $\bar{R}_{iH} = R_F + \beta_{iH}[E(R_H) - R_F]$. The risk premiums from Fama-French and Stulz are used again to demonstrate the difference in the global and local CAPM.

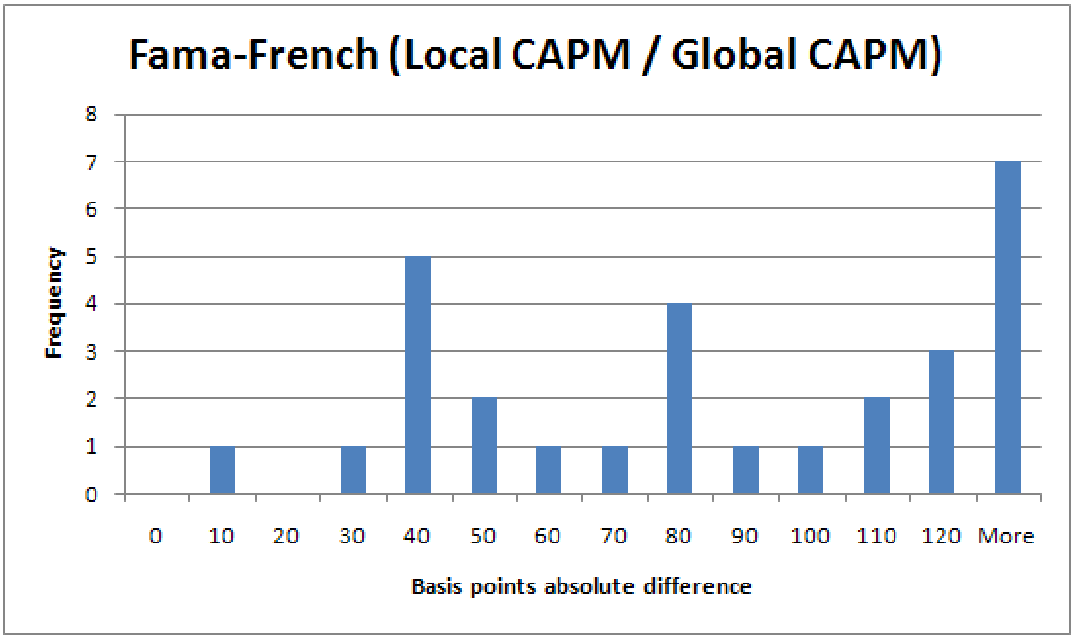


Figure 6 - Cost of equity absolute difference Fama-French: Norway[24]

The Stulz and Fama-French risk premiums illustrate the impact that a small change in risk premium can have on the investment decision for the sample companies in this study.

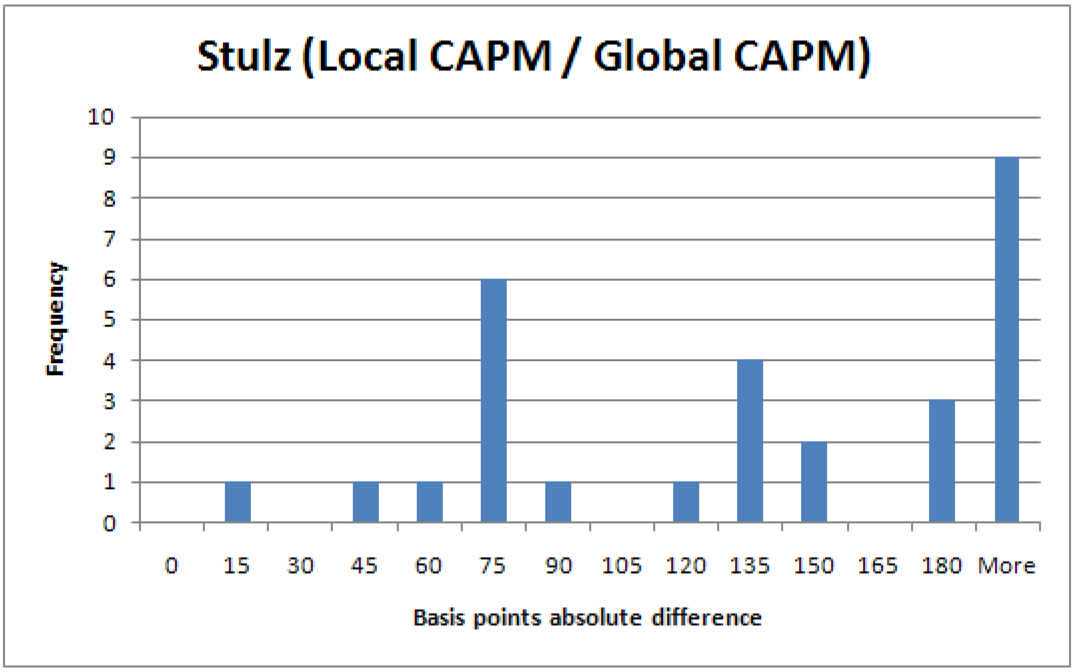


Figure 7 - Cost of equity absolute difference Stulz: Norway

[24] Figure 6 & 7shows a histogram of the absolute differences between the global and local CAPM for the 742 stocks in Norway for the Fama-French and Stulz risk premiums.

7.0 Conclusion

7.1 Main Findings

The main findings of the analysis are that the global and local CAPM valuation models varying quite considerably depending on the country and industry of analysis. The average monthly returns and standard deviations varied quite lot for the countries over twenty years, from low negative to high positive results. This illustrates the difference that exists within the developed world. When analysing the other risk parameters it could be seen that the global and local betas were different for each country with the local CAPM valuations having a t-statistic and R-squared result. This demonstrates that there is a potential danger for managers for several industries and countries of using the incorrect model which could affect their investment decision and impact the shareholder value of the company. This appears to be especially true for the companies in Norway where there was a large difference in value.

The analysis of the Stulz (1995) study with the mispricing of the local CAPM which was found with Nestle, it could be seen that there was a large variation in results. Portugal had the smallest difference between the local and global CAPM, whereas Switzerland had the largest difference. The United Kingdom surprisingly had a quite large difference, while the United States lived up to expectations. The Fama-French and Stulz risk premium demonstrated the differences between the two valuations and impact that they would have on the cost of equity for a company when evaluating a project.

The industry analysis provided some insight into the differences between the industries in the United States and Norway which are impact by the choice between the global and local CAPM. The results demonstrated that there were a number of industries which had a large difference in the United States, but there were many where the difference was very small. Whereas Norway had large differences for the two risk premium measures, and hence make a big difference between using a local and global CAPM.

It appears that although the integration of global developed markets has occurred over a number of years, the markets still differ a bit. In the appendix Figure 12 shows the covariance matrix for the developed countries in this sample. It would appear that the countries do not all behave alike. However, with regard to this study and the factors which have demonstrated differences between the global and local CAPM it is difficult to reject the global CAPM model, since the markets are so open and there appears in certain circumstances to be a large difference between the two models which will impact the manager making the investment decision.

Furthermore, the results have demonstrated that in small countries the difference between the local and global CAPM values have been quite large historically. In addition, the industries which have been established recently also have large differences between the two CAPM measurements. This provides more evidence to the Stulz (1995) that for small countries that the global CAPM should be measurement of choice for managers when assessing a project or investment appraisal. While evidence also suggests that the industries which have not been established for a long time should use the global CAPM. However, large countries like the United Kingdom also experienced large differences between the local and global CAPM, which tends to demonstrate that the global CAPM might be the safest option for all countries and industries.

7.2 Implications for practice

The findings from this thesis should be of interest to the managers in the developed world to evaluate the difference which exists between the local and global CAPM choice. The paper also addresses the impact that internationalisation has had on the developed world and integration of markets. Furthermore, it provides more evidence to support the global CAPM and demonstrate to managers that implications that could arise from using the incorrect value.

7.3 Limitations and further studies

The Fama-French (1993) study of the three factor model could be a nice extension to the study as this would address the size impact of the companies and the pricing error of the local CAPM. The model is roughly based on the Arbitrage pricing Theory (APT), and it takes the idea that there are common factors that explain the difference between the returns.

The SMB factor of the model measures the size risk, with the smaller companies having a logically larger sensitivity to the risk factors since they are relatively undiversified and therefore will not be able to absorb the negative financial events as well as larger companies. This factor accounts for the size premium that exists within stocks, which normally occurs for small stocks which historically have performed better than larger stocks. When the SMB is positive it indicates that the small cap stocks have outperformed the large cap stocks for that specified period.

Whereas the HML factor places a higher risk value on the typical value stocks (high B/M) versus the growth stocks (low B/M). This makes sense when thinking about when a company is seeking an initial public offering they will try to have a low B/M, whereas when they are facing some kind of difficulty they will have a high B/M valuation, and that the market is pricing them fairly in the market place. This focuses on the value premium that exists for investing in stocks which have a high book-to-market value.

The three factor model allows investors to choose the weight of their portfolios such they will be able to have greater or lesser exposure to the various risk factors, and therefore allow them to target specific levels of expected return.

In addition to size and value premium considerations, it would have been interesting to consider the time varying analysis and evaluate the actual time periods which are impacted by the global and local CAPM models. This will help address how the markets have changed over time and whether further integration has occurred and helped to minimise the issue between using the local and global models.

Furthermore, it could also be interesting be evaluate the emerging economies around the world and assess the impact that the choice of model will have on evaluating investment opportunities. However, there might still be a number of issues getting clean reliable data and determining whether the markets are actually efficient.

Bibliography

Alexander, G., Eun, C., & Janakiramanan, S. (1987). Asset pricing and dual-listing on foreign capital markets: anote. *Journal of Finance, 42, March* , 151-158.

Bartholdy, J., & Peare, P. (2003). Unbiased Estimation of Expected Return Using CAPM. *Later published in International Review of Financial Analysis, 12* , 69-81.

Black, F., Jensen, M., & Scholes, M. (1972). The Capital Asset Pricing Model: Some Empirical Tests in studies in the Thory of Capital Markets. *Michael c. Jensen, ed. New York: Praeger* , 79-121.

Cho, D., Eun, C., & Senbet, L. (1986). International arbitrage pricing theory: An empirical investigation. *Journal of Finance 41, no. 2* , 79-121.

Eichengreen, B., & Sussman, Y. N. (2000). The International Monetary System in the Very Long Run. *World Economic Outlook 2000* .

Fama, E., & French, K. (1996). Multifactor Explanation of Asset Pricing. *Journal of Finance, 51* , 55-84.

Fama, E., & French, K. (1992). The Cross-Section of Stock Returns. *Journal of Finance, 47* , 427-465.

Graham, J., & Harvey, C. (2001). The theory and practice of corporate finance: evidence from the field. *Journal of Financial Economics, 60* , 187-243.

Harris, S., Marston, F., Mishra, D., & O'Brien, T. (2003). Ex Ante Cost of Equity Estimates of S&P 500 Firms: The Choice Between Global and Domestic CAPM. *Financial Management (Financial Management Association)* .

Koedijk, K., Kool, C., Schotman, P., & Van Dijk, M. (2002). The cost of capital in international financial markets: local or global? *Journal of International Money and Finance, Elsevier, vol. 21(6)* , 905-929.

Korajczyk, R., & Viallet, C. (1989). An empirical investigation of international asset pricing. *Review of Financial Studies, Vol.2* , 553-585.

Lintner, J. (1965). The valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *Review of Economics and Statistics, 47:1* , 13-37.

Markowitz, H. M. (1959). Portfolio Selection: Efficient Diversification of Investments. *Wiley, Yale University Press, 1970, Basil Blackwell, 1991.*

Mishra, D., & O'Brien, T. J. (2001). A Comparison of Cost of Equity Estimates of Local and Global CAPMs. *The Financial Review, Eastern Finance Association, vol. 36(4)* , 27-47.

Mossin, J. (1966). Equilibrium in a Capital Asset Market. *Econometrica, 34* , 768-783.

O'Brien, T. (1999b). The global CAPM and a firm's cost of capital in different currencies. *Journal of Applied Corporate Finance, Fall* , 73-79.

O'Brien, T., & Dolde, W. (2000). A currency index global capital asset prcing model. *European Financial Management, March* , 7-18.

Philippe, J. (2001). *Value at Risk.* New York: McGraw-Hill,100.

Sharpe, W. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *Journal of Finance, 19:3* , 425-442.

Stulz, R. (1995b). Globalisation, corporate finance, and the cost of capital. *Journal of Applied Corporate Finance, Fall* , 30-38.

Stulz, R. (1999). Globalisation, corporate finance, and the cost of capital. *Journal of Applied Corporate Finance, Fall* , 8-25.

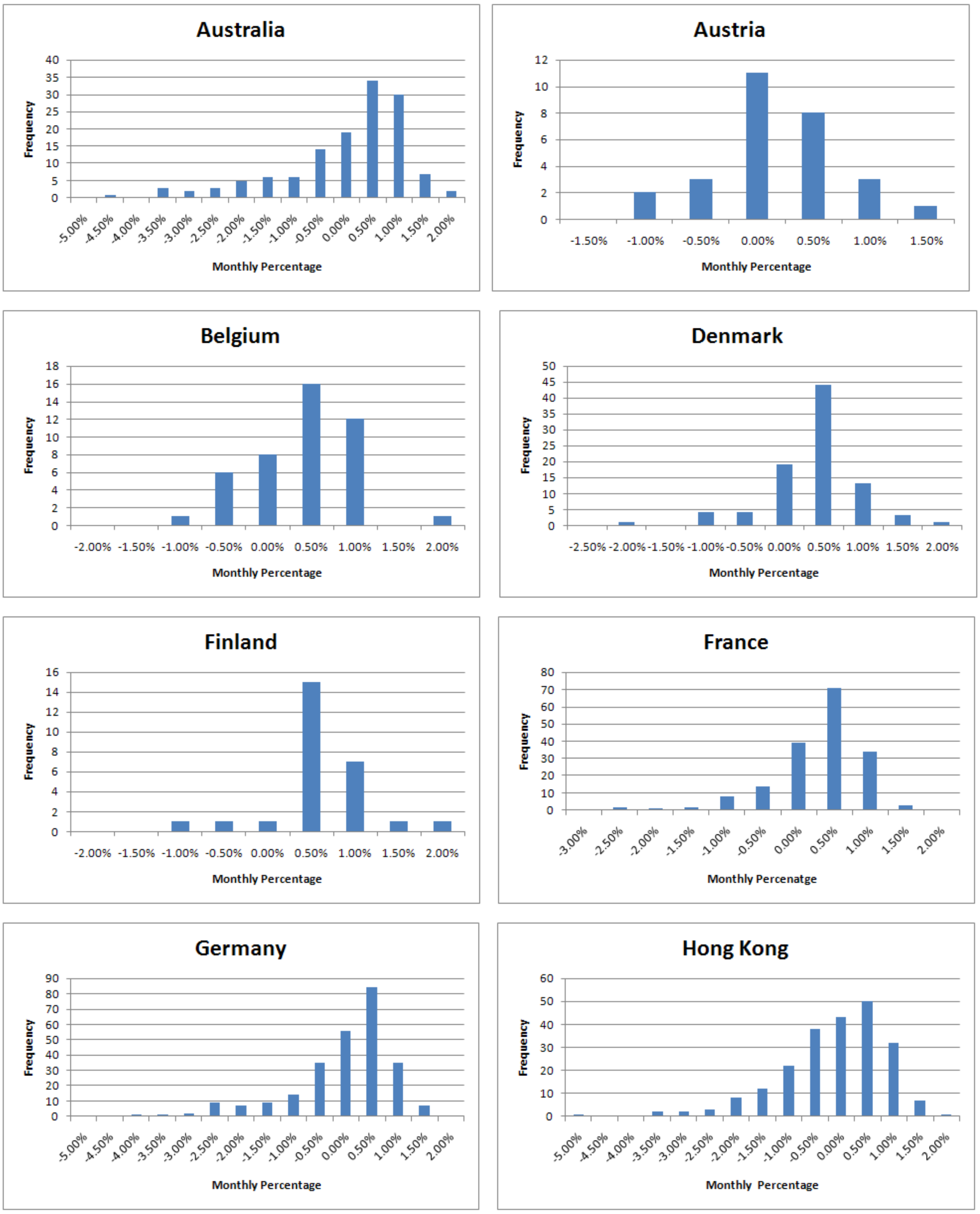
Stulz, R. (1995). The cost of capital in internationally integrated markets: The case of Nestle. *Journal of Applied Corporate Finance* .

Watson, D., & Head, A. (2007). Corporate Finance: Principles and Practice, 4th Edition. FT Prentice Hall.

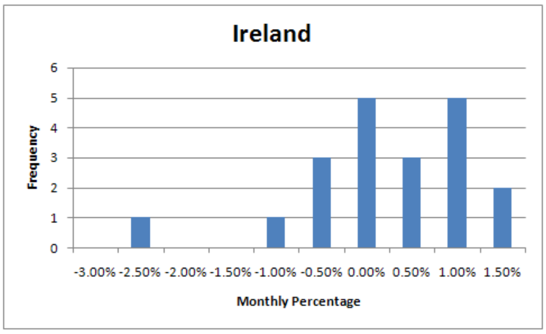
Yurtsever, C., & Zahor, T. (2007). Empirical Test of CAPM using UK Stock Market. *Unpublished* .

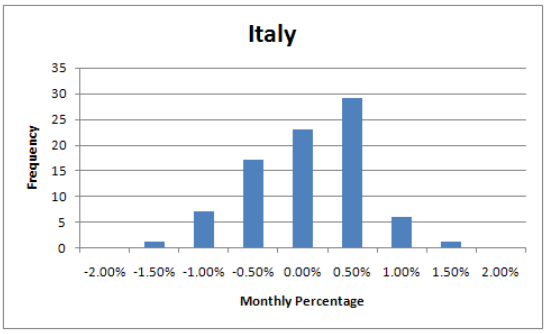
Appendix

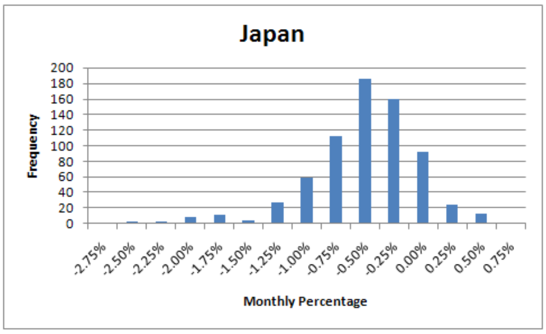
Figure 8 - Average Individual Stock Returns[25]

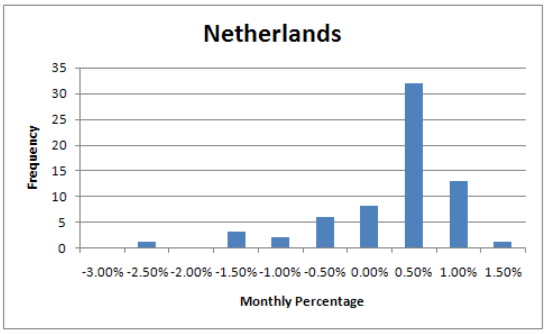


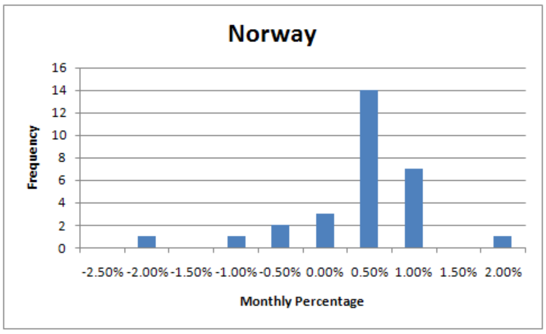
25 Individual stock returns for each country over a twenty year period.

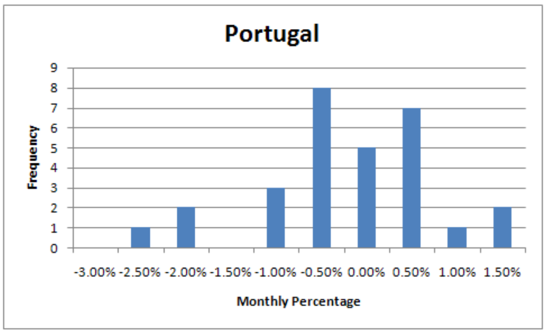

Ireland
Frequency
Monthly Percentage

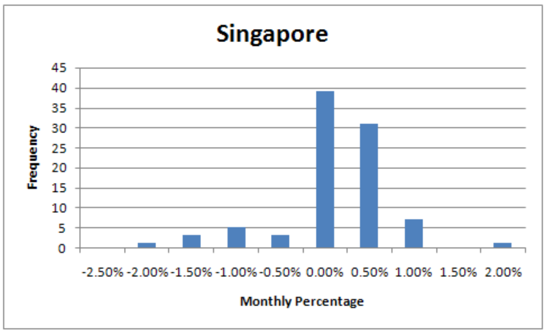

Italy
Frequency
Monthly Percentage

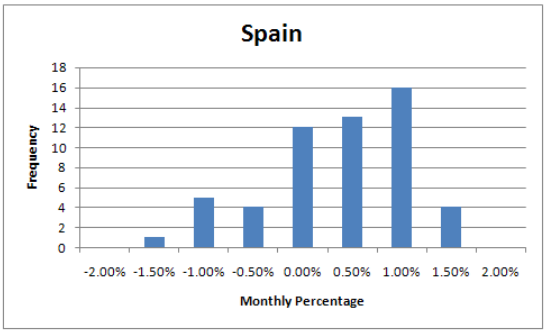

Japan
Frequency
Monthly Percentage

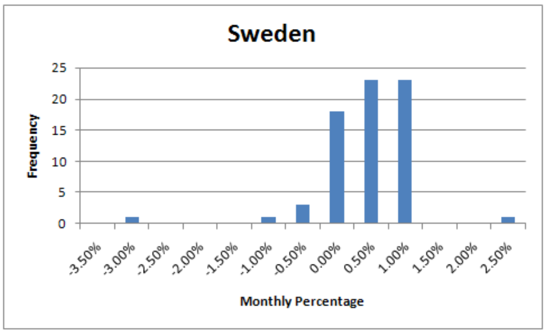

Netherlands
Frequency
Monthly Percentage

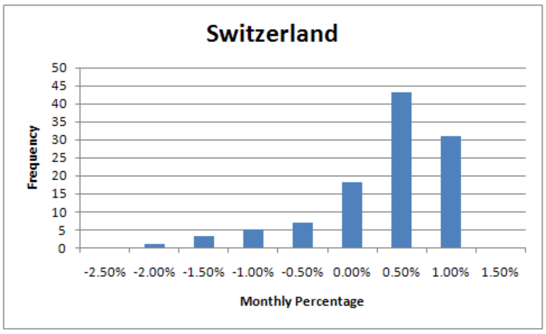

Norway
Frequency
Monthly Percentage

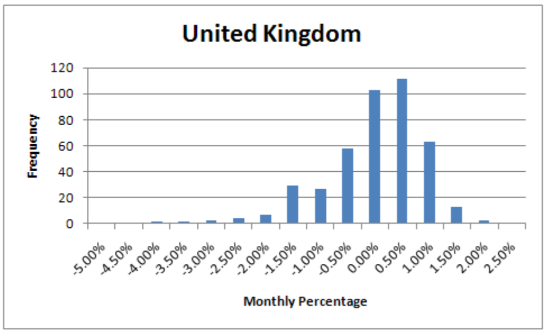

Portugal
Frequency
Monthly Percentage


Singapore
Frequency
Monthly Percentage


Spain
Frequency
Monthly Percentage


Sweden
Frequency
Monthly Percentage


Switzerland
Frequency
Monthly Percentage


United Kingdom
Frequency
Monthly Percentage

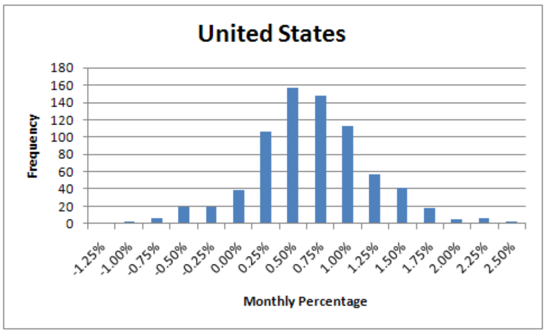
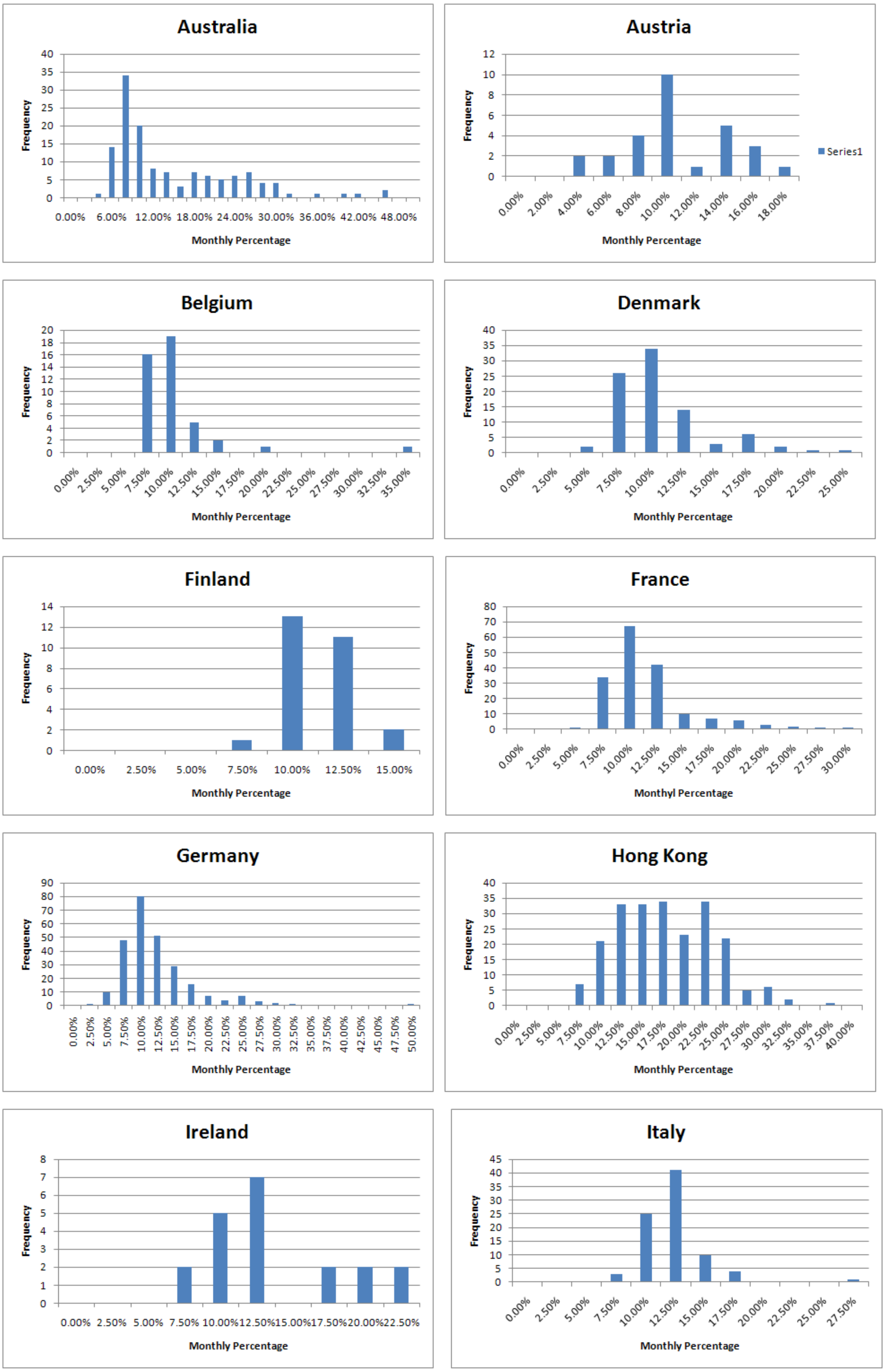
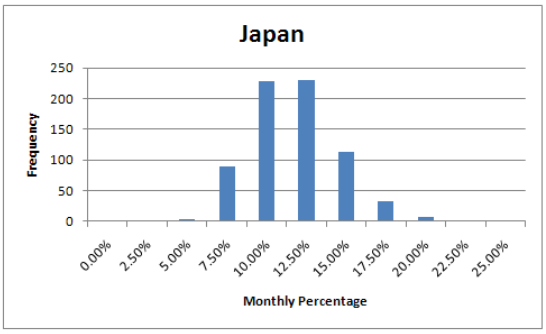
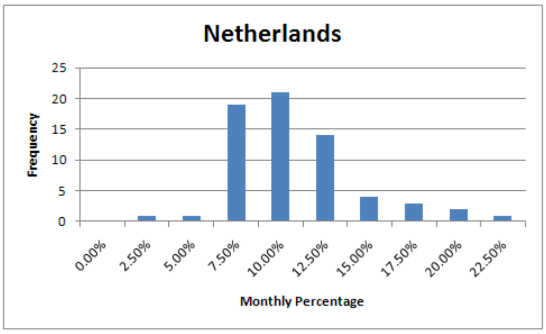

United States
Frequency
Monthly Percentage

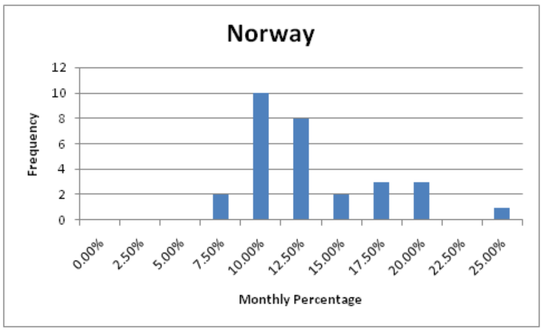
Figure 9 - Standard Deviation Individual Stock Returns[26]

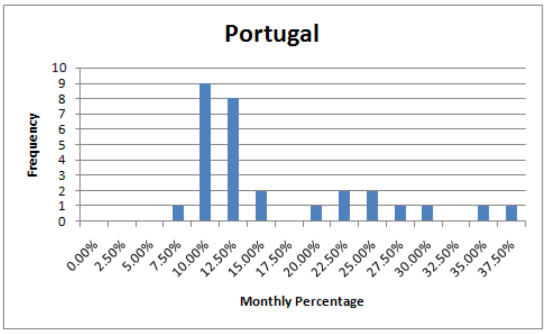


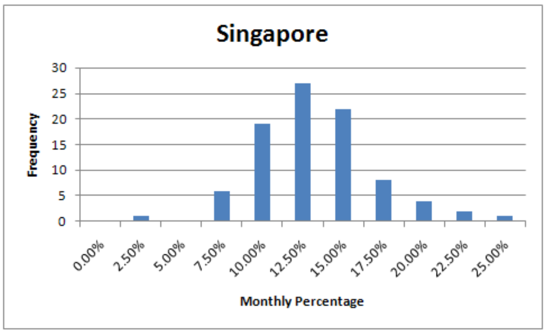
[26] The standard deviation of individual stock returns for each country for a twenty year period.

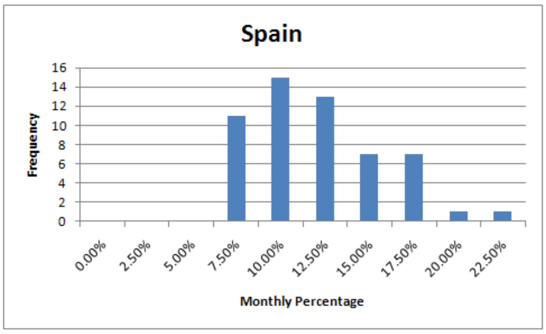

Japan
Frequency
250
200
150
100
50
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50% 25.00%
Monthly Percentage

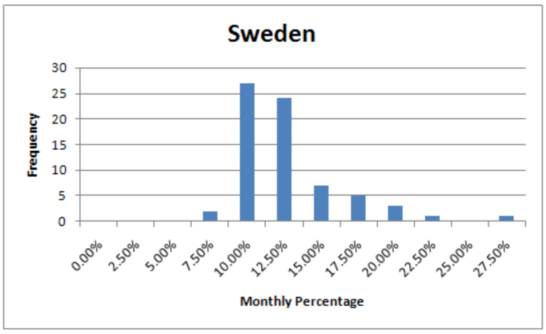

Netherlands
Frequency
25
20
15
10
5
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50%
Monthly Percentage

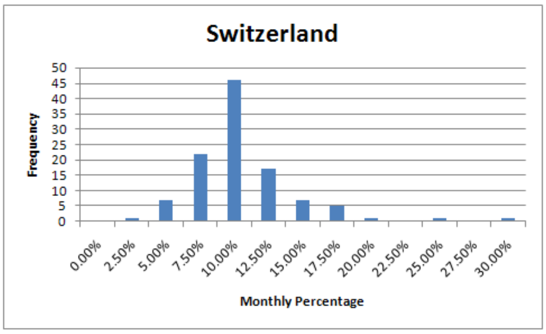

Norway
Frequency
12
10
8
6
4
2
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50% 25.00%
Monthly Percentage

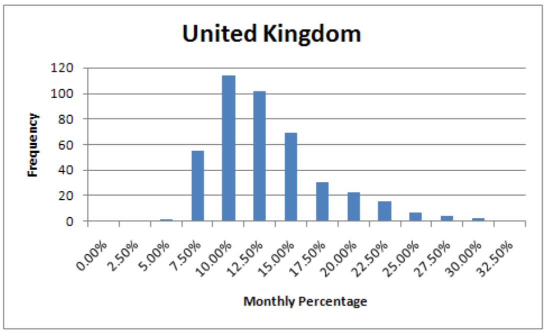

Portugal
Frequency
10
9
8
7
6
5
4
3
2
1
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50% 25.00% 27.50% 30.00% 32.50% 35.00% 37.50%
Monthly Percentage


Singapore
Frequency
30
25
20
15
10
5
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50% 25.00%
Monthly Percentage


Spain
Frequency
16
14
12
10
8
6
4
2
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50%
Monthly Percentage


Sweden
Frequency
30
25
20
15
10
5
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50% 25.00% 27.50%
Monthly Percentage


Switzerland
Frequency
50
45
40
35
30
25
20
15
10
5
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50% 25.00% 27.50% 30.00%
Monthly Percentage


United Kingdom
Frequency
120
100
80
60
40
20
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50% 25.00% 27.50% 30.00% 32.50%
Monthly Percentage

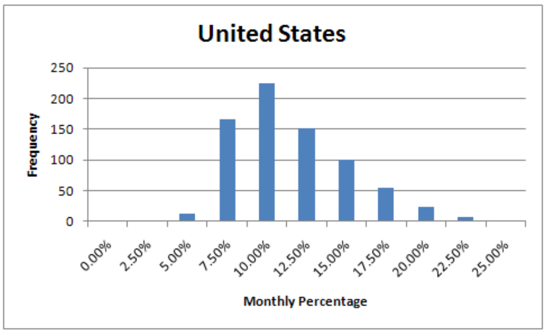
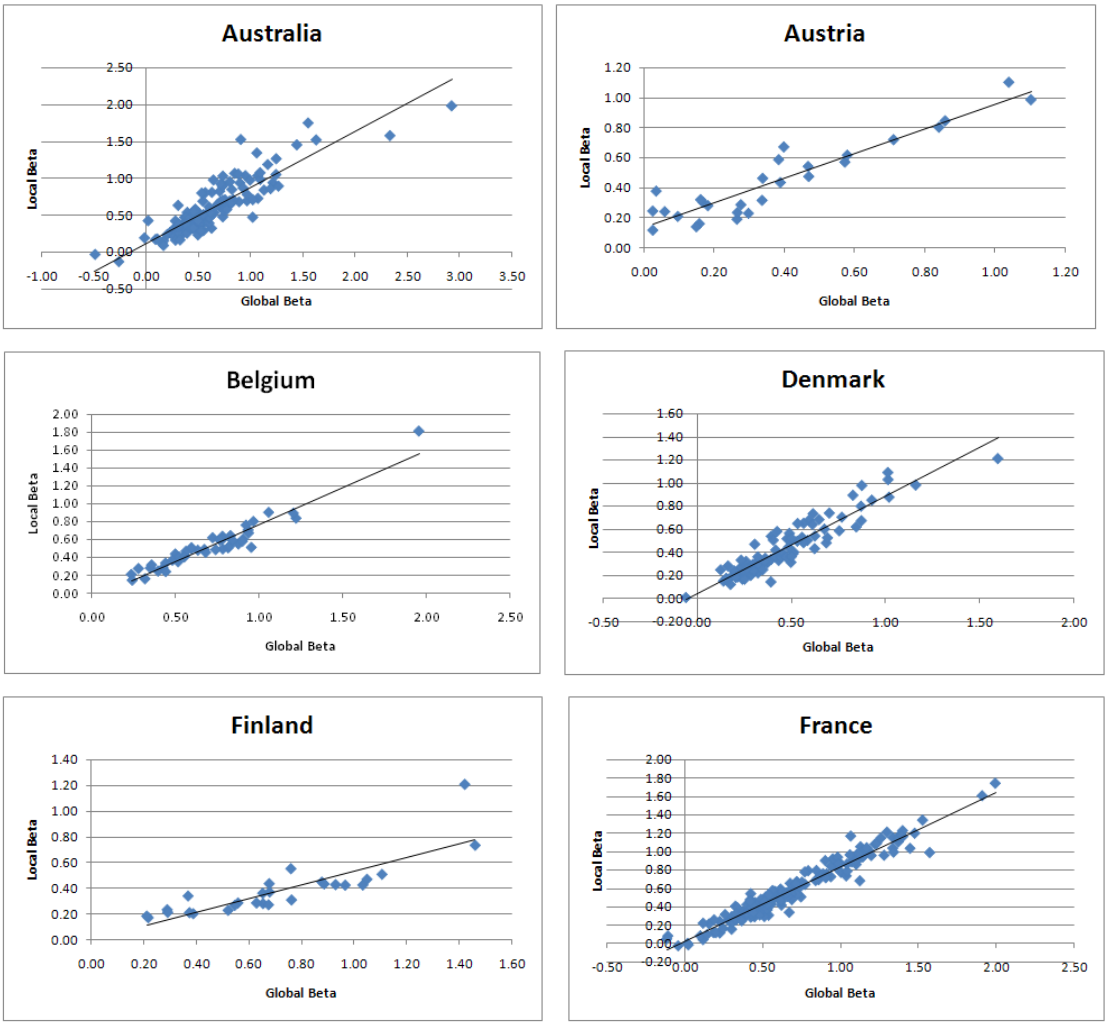
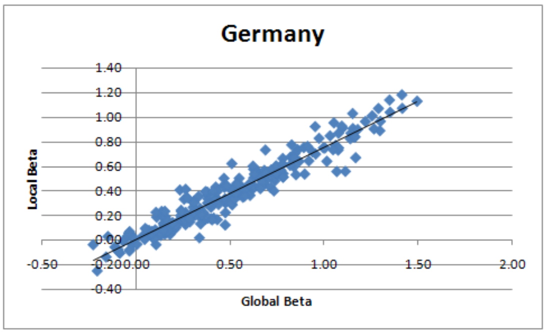
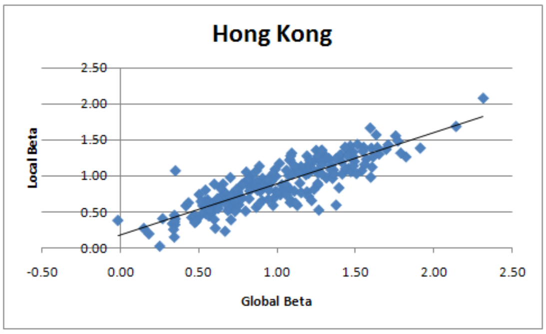

United States
Frequency
250
200
150
100
50
0
0.00% 2.50% 5.00% 7.50% 10.00% 12.50% 15.00% 17.50% 20.00% 22.50% 25.00%
Monthly Percentage

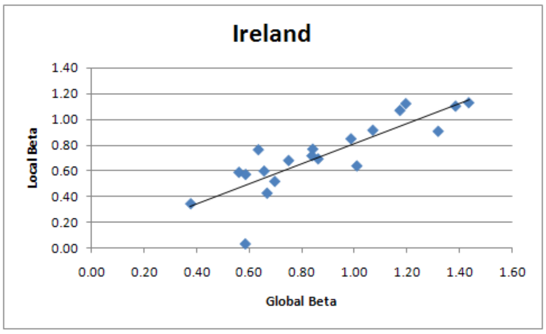
Figure 10 - Global versus Local Estimated Beta[27]

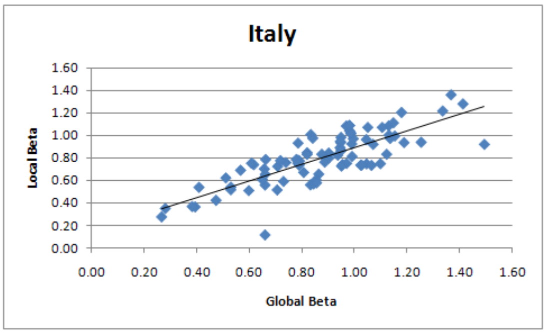


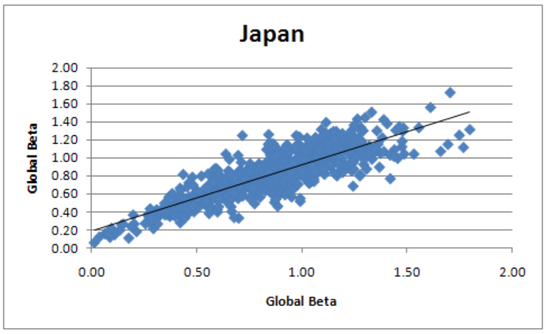
[27] Scatter graphs of the local vs. global beta values for the individual stocks from the twenty countries for a twenty year period.

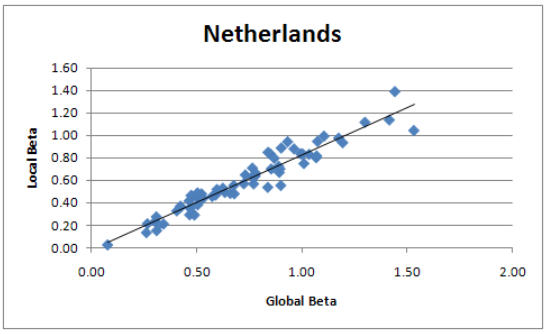

Germany
Local Beta
Global Beta
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.50
0.00
0.50
1.00
1.50
2.00

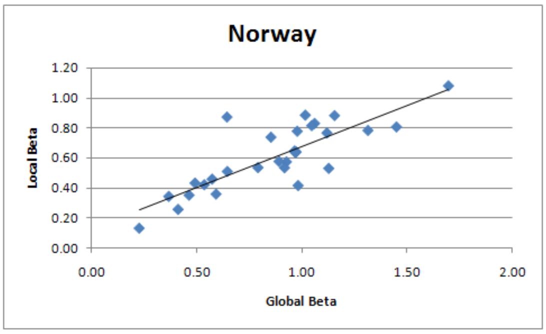

Hong Kong
Local Beta
Global Beta
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
0.00
0.50
1.00
1.50
2.00
2.50

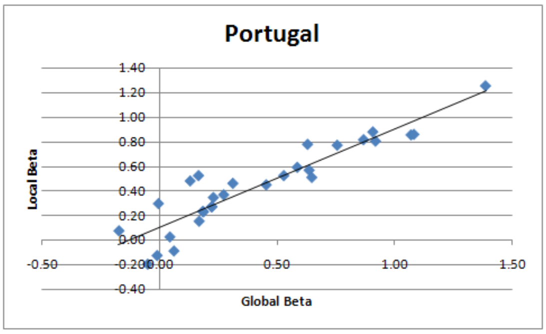

Ireland
Local Beta
Global Beta
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60

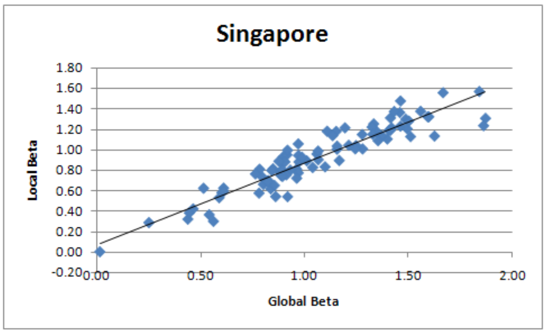

Italy
Local Beta
Global Beta
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60

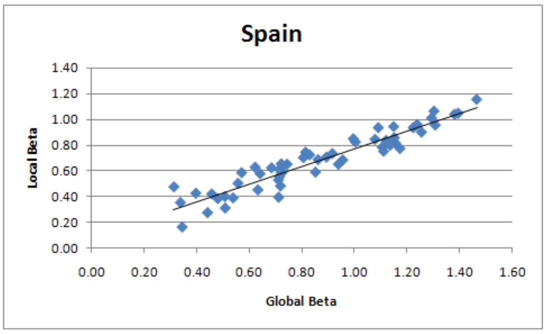

Japan
Global Beta
Global Beta
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.50
1.00
1.50
2.00

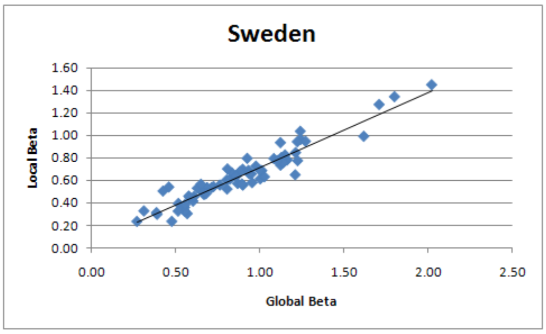

Netherlands
Local Beta
Global Beta
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.50
1.00
1.50
2.00

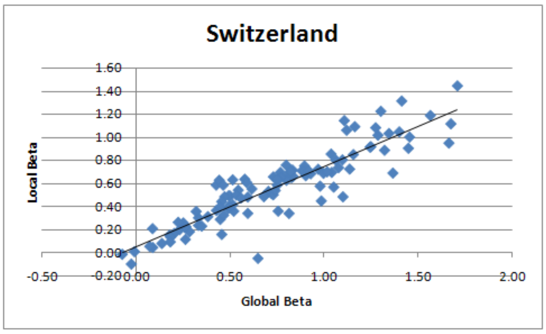

Norway
Local Beta
Global Beta
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.50
1.00
1.50
2.00

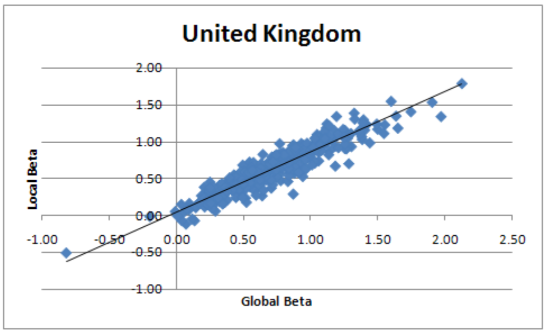

Portugal
Local Beta
Global Beta
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.50
0.00
0.50
1.00
1.50


Singapore
Local Beta
Global Beta


Spain
Local Beta
Global Beta


Sweden
Local Beta
Global Beta


Switzerland
Local Beta
Global Beta


United Kingdom
Local Beta
Global Beta

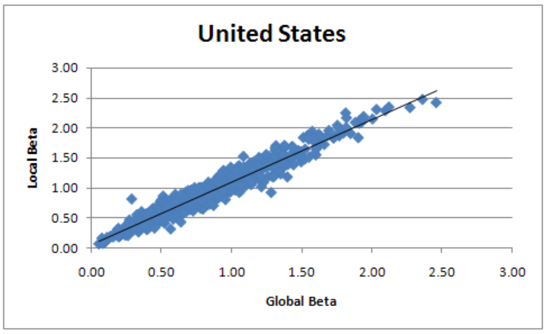
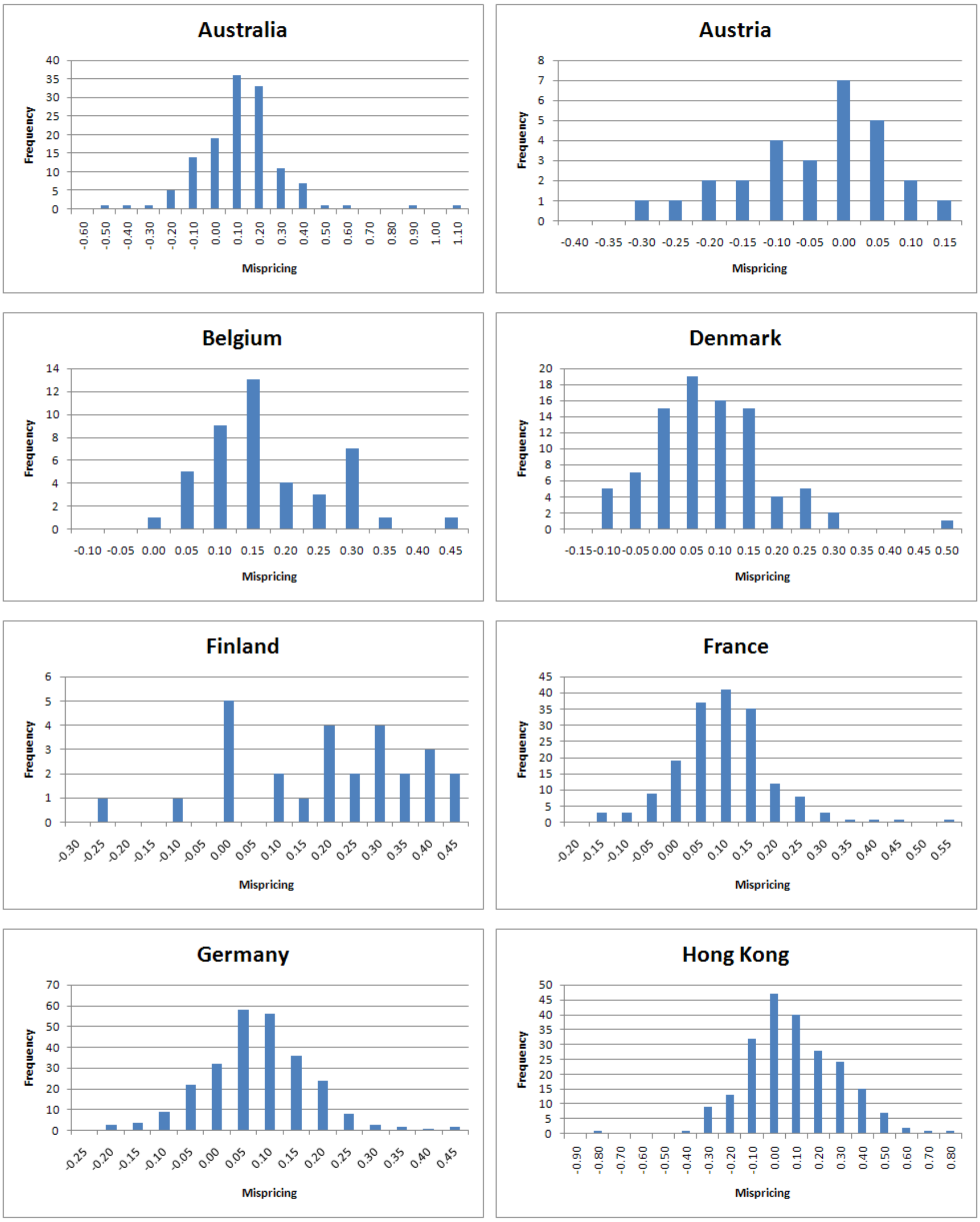
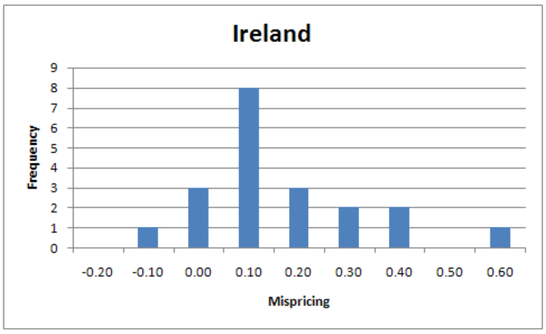
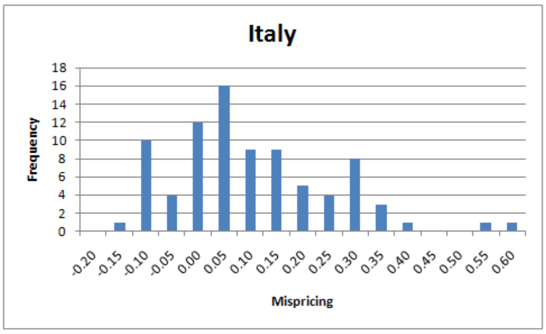

United States
Local Beta
Global Beta

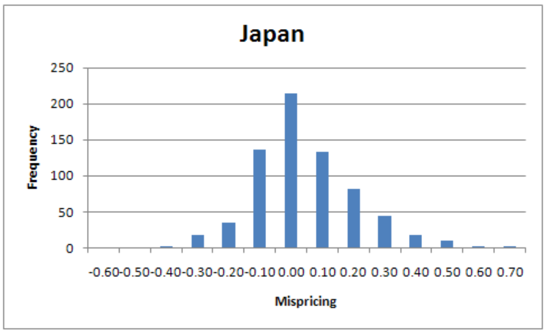
Figure 11 - Mispricing of Local CAPM[28]

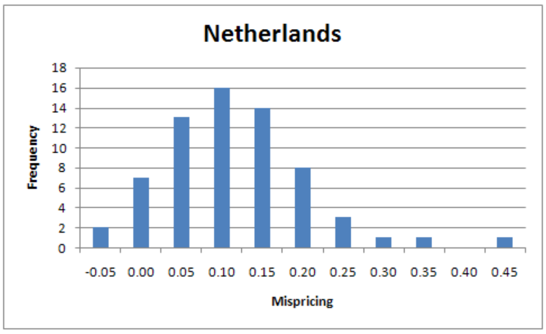


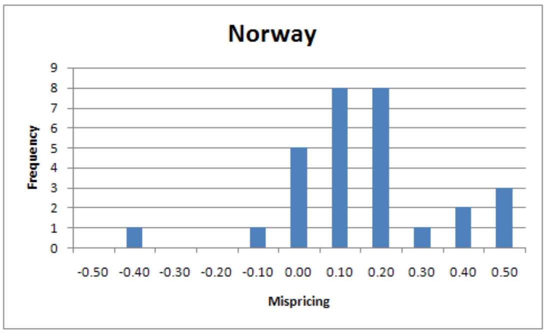
[28] The histograms of the mispricing errors which exists between using the local and global CAPM for a twenty year period.

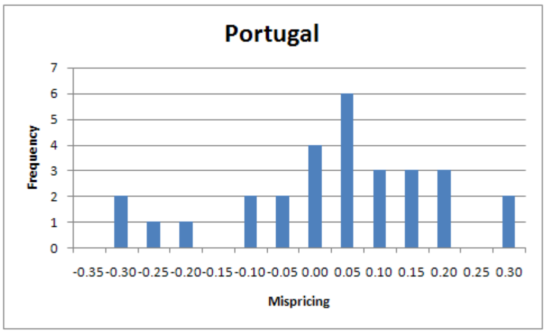

Ireland
Frequency
0 1 2 3 4 5 6 7 8 9
-0.20 -0.10 0.00 0.10 0.20 0.30 0.40 0.50 0.60
Mispricing

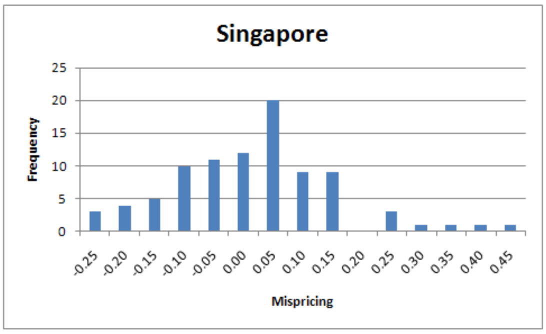

Italy
Frequency
0 2 4 6 8 10 12 14 16 18
-0.20 -0.15 -0.10 -0.05 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Mispricing

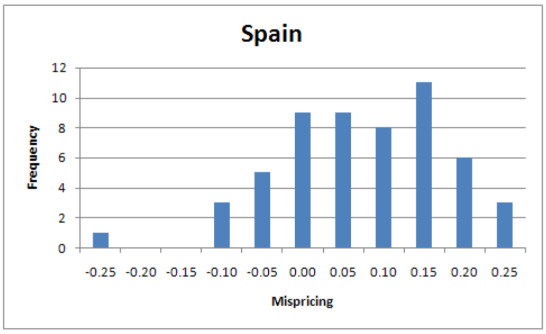

Japan
Frequency
0 50 100 150 200 250
-0.60 -0.50 -0.40 -0.30 -0.20 -0.10 0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70
Mispricing

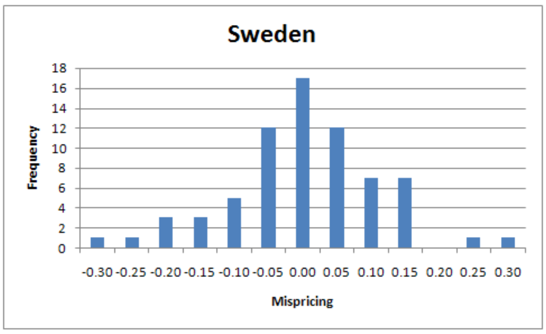

Netherlands
Frequency
0 2 4 6 8 10 12 14 16 18
-0.05 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
Mispricing

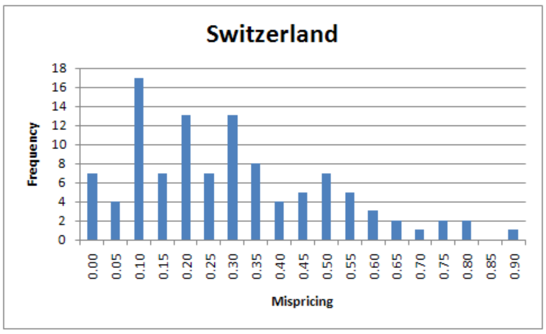

Norway
Frequency
0 1 2 3 4 5 6 7 8 9
-0.50 -0.40 -0.30 -0.20 -0.10 0.00 0.10 0.20 0.30 0.40 0.50
Mispricing

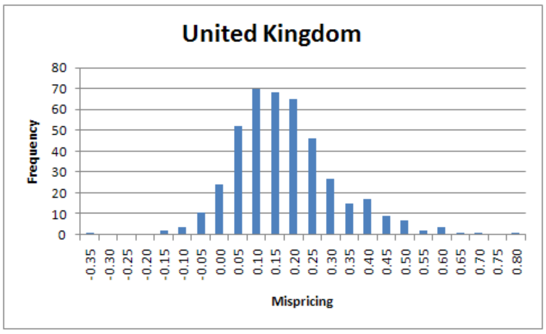

Portugal
Frequency
0 1 2 3 4 5 6 7
-0.35 -0.30 -0.25 -0.20 -0.15 -0.10 -0.05 0.00 0.05 0.10 0.15 0.20 0.25 0.30
Mispricing


Singapore
Frequency
0 5 10 15 20 25
-0.25 -0.20 -0.15 -0.10 -0.05 0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
Mispricing


Spain
Frequency
0 2 4 6 8 10 12
-0.25 -0.20 -0.15 -0.10 -0.05 0.00 0.05 0.10 0.15 0.20 0.25
Mispricing


Sweden
Frequency
0 2 4 6 8 10 12 14 16 18
-0.30 -0.25 -0.20 -0.15 -0.10 -0.05 0.00 0.05 0.10 0.15 0.20 0.25 0.30
Mispricing


Switzerland
Frequency
0 2 4 6 8 10 12 14 16 18
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90
Mispricing


United Kingdom
Frequency
Mispricing

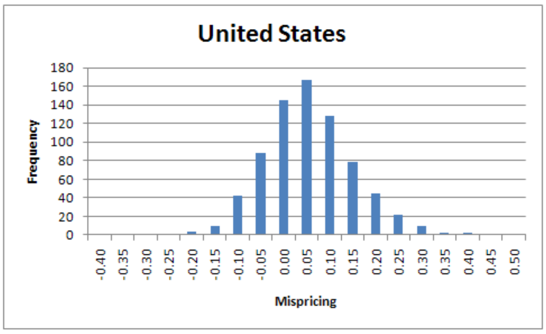

United States
Frequency
Mispricing

Figure 12 - Covariance Matrix Developed Countries[29]

	AZ	AT	BE	DK	FI	FR	DE	HK	IE	IT	JP	NL	NO	PT	SG	ES	SE	CH	UK	US
AZ	0.32%	0.23%	0.21%	0.18%	0.28%	0.19%	0.22%	0.26%	0.21%	0.18%	0.18%	0.21%	0.31%	0.18%	0.27%	0.23%	0.28%	0.14%	0.18%	0.15%
AT		0.55%	0.32%	0.27%	0.24%	0.25%	0.32%	0.27%	0.30%	0.26%	0.17%	0.27%	0.39%	0.26%	0.28%	0.27%	0.28%	0.21%	0.22%	0.14%
BE			0.40%	0.26%	0.23%	0.27%	0.31%	0.21%	0.29%	0.25%	0.15%	0.30%	0.33%	0.27%	0.24%	0.27%	0.29%	0.21%	0.21%	0.17%
DK				0.33%	0.26%	0.23%	0.27%	0.21%	0.24%	0.23%	0.15%	0.24%	0.33%	0.24%	0.21%	0.26%	0.30%	0.18%	0.19%	0.15%
FI					0.92%	0.29%	0.34%	0.31%	0.28%	0.32%	0.23%	0.29%	0.39%	0.27%	0.29%	0.32%	0.49%	0.20%	0.24%	0.24%
FR						0.31%	0.31%	0.22%	0.23%	0.25%	0.16%	0.27%	0.30%	0.26%	0.22%	0.29%	0.33%	0.20%	0.20%	0.17%
DE							0.42%	0.26%	0.27%	0.29%	0.16%	0.31%	0.34%	0.28%	0.27%	0.32%	0.39%	0.22%	0.22%	0.20%
HK								0.60%	0.20%	0.20%	0.18%	0.23%	0.30%	0.20%	0.44%	0.27%	0.32%	0.17%	0.20%	0.19%
IE									0.42%	0.23%	0.19%	0.26%	0.32%	0.24%	0.22%	0.27%	0.30%	0.19%	0.22%	0.17%
IT										0.45%	0.17%	0.23%	0.29%	0.25%	0.22%	0.30%	0.33%	0.16%	0.17%	0.15%
JP											0.42%	0.16%	0.20%	0.15%	0.21%	0.21%	0.24%	0.15%	0.15%	0.11%
NL												0.31%	0.31%	0.25%	0.24%	0.27%	0.32%	0.21%	0.21%	0.18%
NO													0.62%	0.29%	0.33%	0.33%	0.40%	0.22%	0.26%	0.21%
PT														0.42%	0.19%	0.31%	0.33%	0.20%	0.18%	0.14%
SG															0.56%	0.27%	0.33%	0.17%	0.20%	0.20%
ES																0.44%	0.39%	0.21%	0.22%	0.19%
SE																	0.60%	0.24%	0.24%	0.23%
CH																		0.24%	0.16%	0.13%
UK																			0.21%	0.14%
US																				0.19%

[29] A covariance matrix of the index returns for a twenty year period.